

MISSOURI INTEGRATED WATER QUALITY REPORT AND SECTION 303(d) LIST, 2018

Clean Water Act Sections 303(d), 305(b), and 314



**Missouri Department of Natural Resources
Water Protection Program**

**P.O. Box 176
Jefferson City, Missouri 65102**

October 19, 2018

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	v
PART A. INTRODUCTION.....	1
A.1. Reporting Requirements.....	1
A.2. Changes from Previous Report.....	1
A.3. General Overview of the Assessment Approach.....	2
A.4. Organization of Report.....	3
PART B. BACKGROUND.....	3
B.1. Total Surface Waters	3
B.2. Overview of Missouri’s Waters.....	4
<i>Central Plains of Northern and Western Missouri</i>	5
<i>The Ozarks</i>	6
<i>Mississippi Alluvial Basin</i>	7
<i>Great Rivers</i>	7
B.3. Water Pollution Control Program.....	7
<i>Missouri Surface Water Quality Standards</i>	7
<i>Point Source Pollution Control</i>	8
<i>Nonpoint Source Pollution Control</i>	9
<i>Total Maximum Daily Load Program</i>	10
<i>Watershed Based Activities</i>	10
B.4. Cost/Benefit Assessment.....	11
B.5. Special State Concerns and Recommendations.....	12
<i>Agricultural and Urban Land Use as Nonpoint Sources of Pollution</i>	12
<i>Municipal and Industrial Sources</i>	13
<i>Abandoned Mines</i>	13
<i>Concentrated Animal Feeding Operations (CAFOs)</i>	13
<i>Mercury in Fish Tissue</i>	14
<i>Eutrophication</i>	14
<i>Groundwater Protection</i>	15
<i>Additional Concerns</i>	15
PART C. SURFACE WATER MONITORING AND ASSESSMENT.....	15
C.1. Monitoring Program	15
<i>Fixed Station Monitoring</i>	16
<i>Intensive and Special Studies</i>	17
<i>Screening Level Monitoring</i>	18
<i>Probability-based Sampling</i>	19
<i>Monitoring Program Evaluation</i>	20
<i>Data Acquisition and Information Sharing</i>	20
C.2. Assessment Methodology.....	21
<i>Information Used to Determine Designated Use Attainment</i>	21
<i>Water Body Segments</i>	21
C.2.1. Determining Designated Use Attainments.....	22
<i>Statistical Considerations</i>	23
<i>Additional Approaches for Determining Designated Use Attainment</i>	23
C.2.2. Water Body Assignment Categories	23
C.2.3. De-listing Impaired Waters.....	24
C.2.4. Changes to the 2018 Listing Methodology Document	25

C.3. Assessment Results	25
<i>Surface Water Monitoring and Assessment Summary</i>	26
<i>Probability Summary</i>	27
<i>Lake Trophic Status</i>	28
<i>Lake Trends</i>	30
<i>Controlling Pollution in Lakes</i>	31
<i>Five-Part Categorization of Surface Waters</i>	32
<i>Designated Use Support Summary</i>	32
<i>Section 303(d) Assessment Results – List of Impaired Waters</i>	37
<i>TMDL Schedule</i>	38
C.4. Wetlands Programs	38
C.5. Public Health Issues	39
PART D. GROUNDWATER MONITORING AND ASSESSMENT	39
D.1. Groundwater in Missouri	40
D.2. Well Construction and Groundwater Quality	40
D.3. Major Potable Aquifers in Missouri	40
<i>Glacial Till Aquifer</i>	41
<i>Alluvial Aquifer</i>	41
<i>Wilcox-McNairy Aquifers</i>	41
<i>Ozark-St. Francois Aquifer</i>	41
<i>Springfield Aquifer</i>	42
D.4. Groundwater Contamination, Monitoring, and Protection	42
<i>Contamination</i>	42
<i>Monitoring</i>	44
<i>Groundwater Protection</i>	47
PART E. PUBLIC PARTICIPATION	48
REFERENCES	49
APPENDICES	50
APPENDIX A – Methodology for the Development of the 2018 Section 303(d) List	
APPENDIX B – 2018 Missouri Section 303(d) List of Impaired Waters	
APPENDIX C – TMDL Schedule and Section 303(d) Prioritization	
APPENDIX D – Lake Specific Trophic Data	
APPENDIX E – Other Waters Rated as Impaired and Believed to be Impaired	
APPENDIX F – Potentially Impaired Waters	
APPENDIX G – Responsiveness Summary	

LIST OF FIGURES

Figure 1. Aquatic subregions of Missouri	5
Figure 2. Natural regions of Missouri	30

LIST OF TABLES

Table 1. Overview of surface waters in Missouri	4
Table 2. Allocation of designated uses among Missouri's classified waters	26
Table 3. Classified stream miles in Missouri that have been monitored, evaluated, and assessed, 2009-2016.....	26
Table 4. Classified lake acreages in Missouri that have been monitored, evaluated, and assessed, 2009-2016.....	27
Table 5. Probability based support summary of aquatic life use in Ozark Streams.....	28
Table 6. Lake trophic classifications defined by total chlorophyll, total nitrogen, and total phosphorus concentrations, and by secchi depth	29
Table 7. Summary of trophic status for Missouri lakes, by natural division	29
Table 8. Summary of lake trends for four physiographic regions in Missouri	30
Table 9. Amounts (stream mileage and lake acreage) of surface waters assigned to reporting categories	32
Table 10. Designated use support summary for Missouri's classified streams, 2018	33
Table 11. Designated use support summary for Missouri's classified lakes, 2018.	34
Table 12. Causes of impairments for designated uses assigned to Missouri's classified streams	35
Table 13. Causes of impairments for designated uses assigned to Missouri's classified lakes	35
Table 14. Contaminant sources for non-supported designated uses assigned to Missouri's classified streams	36
Table 15. Contaminant sources for non-supported designated uses assigned to Missouri's classified lakes	37
Table 16. Major sources of groundwater contamination in Missouri	43
Table 17. Groundwater contamination summary for all aquifers, 2015-2016	45
Table 18. Groundwater quality sample results reported by public drinking water facilities from 21 counties overlying the Springfield Plateau groundwater province, January 1, 2015 through September 30, 2016	46
Table 19. Summary of groundwater protection programs in Missouri	47

EXECUTIVE SUMMARY

The Missouri Integrated Water Quality Report was prepared by the Missouri Department of Natural Resources to meet requirements stated in sections 303(d), 305(b), and 314 of the federal Clean Water Act (CWA). Section 303(d) requires states to submit a list of waters not meeting water quality standards. Sections 305(b) requires an assessment of surface water quality and summary of monitoring and pollution control activities. Section 314 requires a status and trends assessment of publicly owned lakes. The primary purpose of this report is to provide the U.S. Environmental Protection Agency (EPA) and the residents of Missouri with an update on the condition of surface water quality in the state.

Data used in this report were generated through the Department's monitoring activities and the work of other agencies and organizations operating in conjunction with the Department or independently. Data were assessed using procedures contained in the Department's 2018 Listing Methodology Document (LMD). Monitoring and assessment mainly focused on classified lakes (363,653 acres) and streams (115,772 miles) throughout Missouri.

The 2018 section 303(d) List of impaired waters requiring TMDL studies was approved by the Missouri Clean Water Commission (CWC) on January 4, 2018. This list includes 470 water body-pollutant pairs for both classified and unclassified waters. Common pollutants included bacteria, heavy metals, low dissolved oxygen in water, and mercury in fish tissue. Most common pollutant sources included nonpoint source runoff (agriculture, urban, rural, unspecified nonpoint sources), mining related impacts, atmospheric deposition, and municipal wastewater treatment plants (WWTPs) and other point sources. Sixty-eight water body-pollutant pairs listed in the 2016 Section 303(d) were removed from the 2018 List.

For the 2018 reporting cycle, data were available to assess approximately 115,772 miles of classified streams and 363,653 acres of classified lakes. Of those streams, data indicated 5,740 miles (5 percent) fully supported designated uses that were assessed, while 5,676 miles (5 percent) were found to be impaired for at least one designated use. Major causes for impaired uses included bacteria, low dissolved oxygen, mercury in fish tissue, heavy metals, and limited aquatic macroinvertebrate communities. Major sources of impaired uses included urban and agricultural nonpoint source pollution, municipal point sources, and mining activities. For classified lakes, 185,272 (51 percent) fully supported their designated uses that were assessed, while 72,002 acres (20 percent) were impaired for one or more designated uses. Primary causes of impaired uses in lakes included nutrients, chlorophyll-a, and mercury in fish tissue. Major pollutant sources included urban and agricultural nonpoint source pollution, atmospheric deposition, and municipal point sources.

Trophic status was summarized for 227 lakes (268,054 ac.), where 17 lakes (42,415 ac.) were classified as oligotrophic; 45 lakes (41,461) were mesotrophic; 141 lakes (127,960 ac.) were eutrophic; and, 24 lakes (3,408 ac.) were hypereutrophic. The most notable long-term temporal trends were: (1) an increase in total chlorophyll and a decrease in nonvolatile suspended solids in lakes of the Glaciated Plains; and (2) decrease of phosphorous with a corresponding increase of clarity in lakes of the Ozark Highlands.

PART A: INTRODUCTION

A.1. Reporting Requirements

This report, *Missouri Integrated Water Quality Report for 2018*, was prepared by the Department to fulfill reporting requirements contained in sections 303(d), 305(b), and 314(a) of the federal CWA. CWA Section 303(d) requires each state to identify waters not meeting established water quality standards, and which also lack an approved Total Maximum Daily Load (TMDL) study or a permit requiring adequate pollution control. Water bodies that are on the 303(d) list are commonly known as “impaired waters.” CWA Section 305(b) requires states to submit information pertaining to the overall status of its surface waters, and to provide a description of programs used to monitor and manage water quality and abate any pollution sources. It also provides the opportunity to include a description of groundwater quality in the state, and any related monitoring and protection programs. Under Section 314(a), each state is required to provide an assessment of the water quality of all publicly owned lakes, including a description of their status and trends.

The 2018 Missouri Integrated Report is based on the U.S. Environmental Protection Agency’s *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act* supplemented by memorandums from the Office of Wetlands, Oceans, and Watersheds concerning CWA Sections 303(d), 305(b), and 314 integrated reporting and listing decisions for the 2006, 2008, 2010, 2012, 2014, and 2016 reporting cycles. Under the CWA, the Department is required to report the quality of the state’s waters every two years to the EPA. The EPA compiles all state reports and prepares a summary for the United States Congress on the nation’s waters. The report may then be used for rule making, budget appropriations, and program evaluations by federal legislators.

Missouri has a large network of water resources that is a key component to the quality of life in the state. This network of streams, lakes, and wetlands helps support the energy needs of the state, sustains farming and industrial operations, provides habitat to wildlife, and offers a variety of recreational opportunities. Therefore, the efficacy of the Department’s regulatory and conservation work is imperative. In addition to fulfilling federal reporting requirements, information provided herein is intended to help guide future water resource management efforts in the state.

A.2. Changes from Previous Report

For the 2016 reporting cycle, the main revision to Missouri’s water quality standards included the expansion of the classified rivers/streams and lakes/reservoirs to the 1:100,000 scale National Hydrography Dataset (NHD). The specific uses applied under this provision include aquatic habitat protection, human health protection, and whole-body contact recreation (Category B) and secondary contact recreation. Overall, the processes followed for assessing and interpreting water quality data did not change during the 2018 reporting cycle. Therefore, any changes since the last reporting cycle only include updates to the state’s LMD, *Methodology for the Development of the 2016 Section 303(d) List in Missouri* (reference the web URL: <http://dnr.mo.gov/env/wpp/waterquality/303d/303d.htm>).

The 2018 LMD describes both the data that may be used for stream and lake assessments, and the assessment methods used to interpret water quality standards for 303(d) and 305(b) reporting. The Department is responsible for developing the LMD, which includes methods supported by sound science and advocated by leading experts in a variety of aquatic science fields. In accordance with the Code of State Regulations (CSR) at 10 CSR 20-7.050(4)(A), the 2018 LMD underwent a 100-day public comment period, including additional time following a Clean Water Commission

hearing. During the public comment period two public availability meetings were held. The final 2018 LMD was approved by the CWC on April 6, 2016.

In addition to grammatical correction, there were several revisions made from the 2014 and 2016 LMDs. First, the 2016 LMD was reformatted to blend 2014 appendix information into the main document, along with combining tables to provide a comparison of how waterbodies are determined for listing as impaired or delisted from the 303(d) list. Second was the addition of the Human Health Protection designated use for fish consumption. This only changed the classification of fish tissue impairments previously listed under the Protection of Aquatic Life – Fish Consumption designated use to the Human Health Protection designated use. Third, a section describing Missouri's data solicitation request and requirements were added. Fourth, clarification on how pH and hardness based metals are assessed. For additional information, please see section *C.2.4. Changes to the 2014 Listing Methodology Document*.

A.3. General Overview of the Assessment Approach

The Department's Water Protection Program (WPP) administers several water monitoring programs with the goal of generating sufficient data to assess all waters of the state. Monitoring is centered on three general approaches: (1) fixed station monitoring; (2) intensive surveys; and, (3) screening level monitoring. WPP monitoring may also be used to support various Department initiatives, and respond to problematic issues that emerge. In addition, the Department partners with outside agencies, organizations, and universities to meet its data needs, and it coordinates monitoring among these groups to obtain a comprehensive set of information for assessing state waters. While this approach does not cover all waters of the state, its goal is to provide the greatest scope and quality of coverage possible given the availability of resources. Detailed information regarding departmental and external monitoring programs used to satisfy reporting requirements under the CWA can be found in section *C.1. Monitoring Program*.

Designated uses were assessed whenever sufficient data of reliable quality were available, and previous assessments were updated whenever an adequate amount of new information became available. In some cases, errors that were discovered in previous assessments were corrected. For assessing use attainment, recent data (i.e., less than 7 years old) were preferred. Due to resource limitations, however, there were instances where data older than 10 years were used for assessments if the data were considered representative of present conditions.

In general, surface water assessments in this report were largely based on biological, water quality, physical habitat, fish tissue, and toxicity data collected through 2016. Monitoring predominantly utilized a targeted sampling design that focused on selected waters, and which provided the majority of the data used for water quality-based assessments reported here. To a lesser extent, a probabilistic sampling design was used as a secondary approach for assessing state waters. These data were derived from the Missouri Department of Conservation's (MDC) Rapid Assessment Monitoring (RAM) program and were based on fish community data. The Department, through EPA's Section 319 Nonpoint Source Grant Program, provided funding to the University of Missouri-Columbia to support two lake monitoring programs, the Statewide Lakes Assessment Program (SLAP) and the Lakes of Missouri Volunteer Program (LMVP). These data were used to track lake trophic status throughout Missouri and to evaluate water quality trends for lakes with sufficient data.

While surface water assessments were the focus of this report, groundwater information was also included. The Department's Public Drinking Water Branch is the lead state entity responsible for monitoring groundwater quality in Missouri. Groundwater monitoring information is provided along with a summary of groundwater contamination and an overview of the programs available

to prevent or remediate such problems. For additional information about the Public Drinking Water Branch beyond what is presented in this report, please see the Department's website at <http://dnr.mo.gov/env/wpp/dw-index.html>.

A.4. Organization of Report

Subsequent sections of this report are separated into four general categories. Part B provides background information on streams and lakes within the state, describes the Department's water management approach and any programs that protect and improve the quality of surface water, gives an overview of costs and benefits of water management in the state, and provides a summary of important issues affecting water quality and associated management programs. Part C describes ongoing water monitoring programs administered by the Department, methodologies used to make assessment determinations for Section 303(d) listings, and major findings resulting from the assessment process. Part D focuses on the status of groundwater resources in the state and related protection and monitoring efforts. Part E discusses Department procedures for public participation and stakeholder involvement in the development of the Section 303(d) list. Appendices at the end of this report are reserved for listing waterbody-specific water quality, Section 303(d) prioritization, and other important supporting documents. Appendix B contains the recently approved 2018 Section 303(d) List of impaired waters in Missouri by the Missouri Clean Water Commission.

PART B: BACKGROUND

B.1. Total Surface Waters

Missouri is home to slightly more than 6 million people with approximately one-half of the state's population residing in the metropolitan areas of Kansas City and St. Louis (US Census Bureau 2016). These cities were settled on the Missouri and Mississippi rivers – two of the nation's great rivers – which are essential to the economies of the regions. Beyond the two great rivers, Missouri's landscape contains a network of streams and lakes. These waters are expected to meet the needs of municipal, industrial, and agricultural operations and simultaneously serve as sources of safe drinking water, recreational sites, and wildlife habitats.

Classified streams in Missouri total 115,772 miles and classified lakes cover an area of 363,653 acres (Table 1). Classified streams and lakes include those waters listed in Tables G and H of Missouri's Water Quality Standards at 10 CSR 20-7.031. Classified waters are given priority under the Department's current water monitoring program. Unclassified streams contribute another 142,666 miles to Missouri's stream network, while unclassified lakes provide an additional 68,302 acres of surface area. Unclassified streams and lakes refer to waters not listed in Tables G and H of Missouri's Water Quality Standards, but that are still considered waters of the state. Unclassified waters are afforded protection under Missouri's water quality standards, albeit to a lesser extent than classified waters. In order to be considered a classified wetland under Missouri's Water Quality Standards 10 CSR 20-7.031(1)(F), wetlands must meet criteria established in the *United States Army Corps of Engineers Wetlands Delineation Manual 1987*; however, a defined set of classified wetlands does not exist at this time. Previous work by the Department's Division of Geology and Land Survey estimated wetland coverage in the state to be approximately 624,000 acres (Epperson 1992). In comparison, the United States Fish and Wildlife Service's National Inventory of Wetlands currently estimates approximately 1.4 million acres of wetlands exist in Missouri. This estimate is based on palustrine wetland types that include classified and unclassified streams and lakes, or portions of such. Regardless of the source, only estimates of wetland coverage exist for Missouri at this time, and a more precise

measurement will not be available until a classified set of wetlands is formally adopted by the state.

Table 1. Overview of surface waters in Missouri.

Topic	Value	Scale	Source
State population (number)	6,093,000	N.A.	US Census Bureau, 2016 estimate
State surface area (sq. miles)	68,742	N.A.	US Census Bureau
River sub-basins (8-digit HUCs)	66	1:24,000	USGS NHD and USDA NRCS WBD
Classified stream (miles)	115,772	1:24,000	WPP MUDD
Perennial (miles)	13,309	1:24,000	WPP MUDD
Intermittent (miles)	102,463	1:24,000	WPP MUDD
Losing streams (miles)	37,027	1:24,000	MGS
Great Rivers (miles)	1,053	1:24,000	WPP MUDD
Springs (number mapped)	4,487	1:100,000	MGS
Classified lakes (acres)	363,653	1:24,000	WPP MUDD
Unclassified streams (miles)	142,666	1:24,000	USGS NHD
Unclassified lakes (acres)	68,302	1:24,000	USGS NHD
Freshwater wetlands (acres)	624,000	1:24,000	MGS

USGS NHD - United States Geological Survey, National Hydrography Data Set; USDA NRCS WBD - United States Department of Agriculture, National Resources Conservation Service, Watershed Boundary Dataset; WPP MUDD - Water Protection Program, Missouri Use Designation Dataset; MGS - Missouri Geological Survey.

B.2. Overview of Missouri's Waters

Natural lakes in Missouri are limited to oxbow lakes, sinkhole ponds in karst areas, and open water systems in the wetlands of southeastern Missouri (Nigh and Schroeder 2002). Man-made lakes and ponds are common throughout the state. These systems range in size from large reservoirs created for hydroelectric generation and water supply to small ponds used for livestock watering and recreation. The two largest reservoirs in the state are Lake of the Ozarks (59,520 acres) and Harry S. Truman Reservoir (55,600 acres).

The state's stream systems are diverse, and their physical characteristics reflect those of their watersheds. Missouri's streams can be grouped into three aquatic subregions: the Central Plains, the Ozark Plateau, and the Mississippi Alluvial Basin (Figure 1) (Sowa *et al.* 2005). The subregions are distinct with regard to terrain and geology, historical and present day land cover, and stream morphology. Streams in each aquatic subregion generally have similar structural features and functional processes, which result in unique aquatic assemblages and ecological compositions.

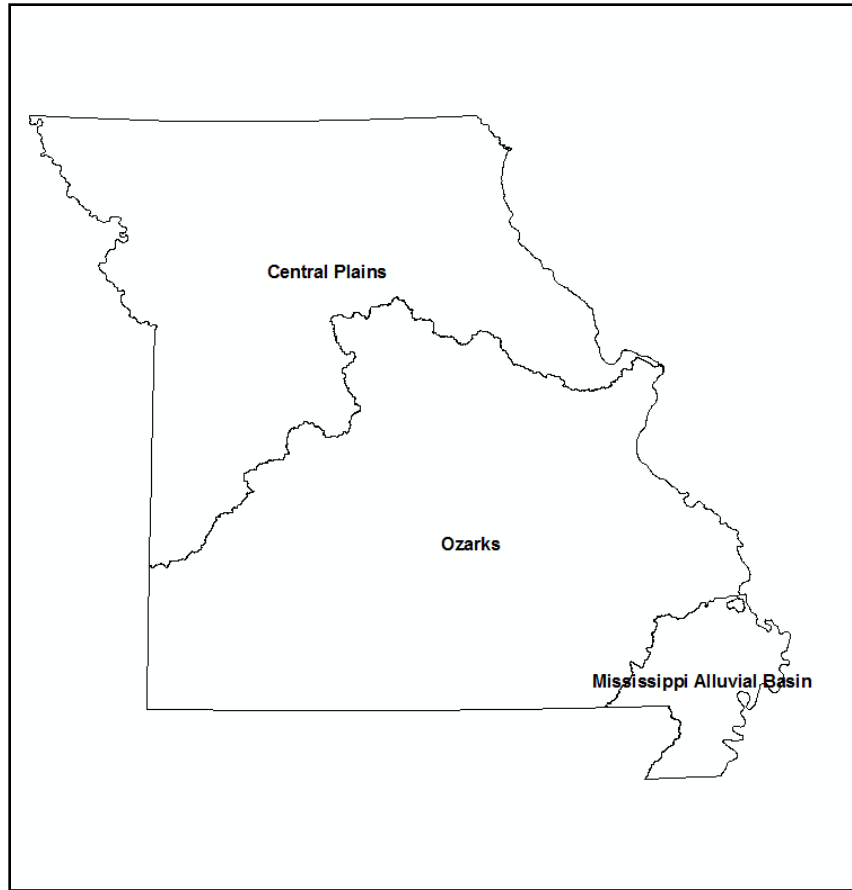


Figure 1. The Aquatic Subregions of Missouri.

Central Plains of Northern and Western Missouri

The Central Plains cover the northern section of Missouri and extend down to the state's west-central region. This western area formerly consisted of broad expanses of prairie, while the northern section contained smaller tracts of prairies separated by forests in valleys and on steeper slopes. The land is underlain by bedrock containing several relatively impermeable shale and clay layers. Today this land is dominated by row crops on the flattest areas with the richest soils, with pasture on irregular surfaces, and forests on some of the roughest tracts. Forests of northern Missouri are more abundant today than they were historically (Nigh and Schroeder 2002).

Surface waters are generally turbid and affected by high rates of sediment deposition. Soil erosion induced sediment deposition degrades aquatic habitat and stresses aquatic life. Up to 8,000 miles of classified streams may be affected by these processes or other types of degradation of aquatic habitat, such as flow modification or channelization that accompany this region's land use.

Rivers and reservoirs used as drinking water supplies experience contamination from herbicides. In the recent past, several reservoirs that served as public drinking water reservoirs exceeded drinking water standards for the herbicide atrazine or health advisory levels for the herbicide cyanazine. Currently, there is just one reservoir listed as impaired for atrazine – Lewistown Lake in Lewis County. Local watershed management programs aimed at reducing herbicide runoff have been relatively effective. Several other herbicides are occasionally found in drinking water reservoirs, but at concentrations below health advisory levels.

The quality of groundwater in northern and western Missouri is also influenced by the geology of the area. Public water supply sources include reservoirs and wells. The wells obtain water primarily from glacial drift deposits in portions of north-central and western Missouri. Wells in western Missouri, south of Kansas City, obtain water from limestone aquifers, except for the extreme western limits of Missouri near the state border with Kansas. Private water supplies are obtained from glacial drift deposits and from underlying limestone bedrock in portions of northwestern, central, eastern, and northeastern Missouri. However, deep bedrock wells in many north-central and northwestern Missouri locations tap water supplies that are too mineralized for drinking water purposes. It is believed that some private wells in this part of Missouri may exceed the drinking water standard for nitrate, and a very small number may exceed the standard for pesticides. This trend is most frequently caused by localized surface contamination of the wellhead and does not represent widespread contamination of the aquifer. Deeper aquifers are generally protected from surface contamination by impermeable strata.

The Ozarks

The hilly topography of the Ozarks region contains areas with the greatest relief in the state. Pre-settlement vegetation was dominated by forests to the east, woodlands in the central and western Ozarks, and prairies along the outer boundary of the subregion. Currently, the eastern Ozarks is dominated by forest cover whereas the western Ozarks have considerably more land in crops and pasture, with woods concentrated on steeper terrain. The bedrock – consisting of limestone, dolomite, and sandstone – yields groundwater of excellent quality and of a volume generally adequate to supply urban, industrial, and other needs. The soil or subsoil has developed from weathering of bedrock formations and is typically 20 to 80 feet thick. Some areas have extremely thin soils, but in locations where weathering has been extensive, soils may be 100 feet thick or more. The subsoil has moderate to high infiltration rates, which contribute to the recharge of groundwater supplies. Streams are typically entrenched into bedrock and influenced to some degree by groundwater flow from large springs (Nigh and Schroeder 2002). Losing streams, those that lose flow through the stream bed to underground, occur in karst regions of the Ozarks.

Ozark streams are generally clear, with baseflows well sustained by many seeps and springs. Some streams and reservoirs in the Ozarks are becoming nutrient and algae enriched as a result of increasing human population and domestic animal production in their watersheds.

Groundwater contamination risks are moderate to high due to the permeability of the soil and bedrock. A variety of surface activities, including agricultural and suburban-urban stormwater and wastewater disposal, mining, stormwater runoff, lawn care, improper well construction or closure, and individual onsite wastewater disposal practices, pose threats to surface water and groundwater quality. However, overall water quality remains good as a result of efforts to protect vulnerable aquifers in the Ozarks.

Groundwater is relied upon heavily for a drinking water supply in this part of Missouri. Most municipalities in the southern half of the state exclusively use groundwater for their drinking water. The number of private drinking water wells statewide is not known, but is probably between 100,000 and 250,000, mostly south of the Missouri River. One major groundwater concern is the potentially rapid and unfiltered transmission of contaminated surface runoff or leachate (e.g., septic tanks, underground storage tanks, landfills, animal production or processing waste, etc.) through fractures or sinkholes directly into potable aquifers. Properly cased wells into deep aquifers rarely encounter water quality problems, but shallow or improperly cased wells are at risk.

Mississippi Alluvial Basin

The Mississippi Alluvial Basin consists of flat terrain that at one time was largely covered by seasonal or perennial wetlands called “swamp forests.” Nearly all of the historic land cover in this region has been converted to crop production, many streams have been channelized, and the land is drained by hundreds of man-made ditches. The natural hydrography of perennial and seasonal wetlands has been modified here more than anywhere else in Missouri and aquatic habitat degradation is widespread.

Groundwater is abundant due to high infiltration rates on these flat fields. Public water supplies that tap deeper aquifers provide good quality water, but shallow private wells may have nitrates and low levels of pesticides at times. The exceedance frequency of drinking water standards for nitrates and pesticides in private wells would be roughly similar to that in northern Missouri.

Great Rivers

The Great Rivers, the Missouri and Mississippi rivers, are not classified as a subregion of their own, but are unique aquatic ecosystems and represent a significant water resource of Missouri. Approximately 1,053 miles of Great River habitat fall under Missouri’s jurisdiction. Great Rivers support a wide array of industrial and commercial needs, numerous recreational opportunities, and are utilized as primary sources of drinking water for many communities. Fish fauna of Great Rivers is comprised of a distinct assemblage of species, some of which occur nowhere else in Missouri (Pflieger 1997).

In northern Missouri, where surface and deep aquifer supplies are unreliable, many towns depend on the alluvial aquifer of nearby rivers. Landfills and industrial land use in Kansas City and St. Louis have historically been located on river floodplains and have caused local contamination of the Mississippi River and Missouri River aquifers near St. Louis and the Missouri River aquifer in Kansas City. While alluvial aquifers of the Great Rivers may yield large quantities of groundwater, pumping induces recharge from the rivers which is a potential source of contamination. Some municipal water supplies have been impacted by groundwater contamination in the past, and thus groundwater from these aquifers requires treatment.

B.3. Water Pollution Control Program

Missouri Surface Water Quality Standards

Authority for enforcing Missouri Clean Water Law and state regulations concerning water pollution resides with the Department’s WPP. Missouri’s approach to water quality management is primarily based on its water quality standards provided in 10 CSR 20-7.031. Under this rule, waters of the state are protected for specific designated uses. Water quality standards are the basis for protecting designated uses, which in Missouri include: (1) drinking water supply; (2) human health protection - fish consumption; (3) whole body contact recreation (e.g., swimming); (4) secondary contact recreation (e.g., fishing and wading); (5,6) aquatic life protection for general warm water and limited warm water fisheries; (7,8) aquatic life protection for cold water and cool water fisheries; (9,10) aquatic life protection for ephemeral and modified aquatic habitats, (11) irrigation; (12) livestock and wildlife watering; and (13) industrial water supply. The Department is responsible for developing scientifically-based water quality standards and proposing them to the Missouri CWC for adoption into state regulations. In accordance with the federal CWA, Missouri is required to review and update water quality standards at least once every three years.

To determine if designated uses are being protected, two general modes of water quality standards are used, narrative and numeric criteria. Narrative criteria are essentially protective descriptions that may be measured using numeric values. For example, 10 CSR 20-7.031(4)(D) states that waters shall be free from substances or conditions in sufficient amounts to result in

toxicity to human, animal, or aquatic life. Quantitative methodologies then utilize numeric values to determine if a narrative criterion is exceeded and if substance(s) is/are having a toxic effect on human, animal, or aquatic life. In some cases, narrative criteria alone may be used to assess attainment of designated uses. For example, under 10 CSR 20-7.031(4)(A), waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly, or harmful bottom deposits to prevent full maintenance of designated uses. Streams with dense mats of floating sewage scum are in violation of this narrative standard. Numeric criteria are essentially water quality limits used to determine if designated uses are attained or not. Quantitative methods always use measured numeric values to examine if the numeric criterion is being upheld.

Additional protection to state waters is provided in the antidegradation component of water quality standards as contained in 10 CSR 20-7.031(3). Missouri's antidegradation policy consists of a three-tiered system. In the first tier, public health, in-stream uses, and a level of water quality necessary to protect in-stream uses shall be maintained and protected. In the second tier, in cases where water quality is better than applicable water quality criteria, the existing quality shall be protected and maintained. Lowering of in-stream water quality is only allowed in such cases when it is determined to be a necessity for important economic and social development. This second tier also contains a set of strict provisions that must be followed for any permitted degradation of state waters. According to the third tier, there shall be no degradation of water quality in outstanding national resource waters or outstanding state resource waters as listed in Tables D and E of 10 CSR 20-7.031.

Point Source Pollution Control

The Department, under the State of Missouri's authorization, administers a program equivalent to the National Pollution Discharge Elimination System (NPDES). Under Missouri Clean Water Law, the Department issues permits for discrete wastewater discharges (e.g., human wastewater, industrial wastewater, stormwater, confined animal operations, etc.) that flow directly into surface waters. Industrial, municipal, and other facilities are regulated in order to ensure that surface waters receiving effluent from these sources meet water quality standards. Permits include requirements for limitations on specific pollutants (e.g., biochemical oxygen demand, ammonia as nitrogen, chloride, etc.), monitoring and reporting, and the implementation of best management practices (BMPs) as needed. The Department requires wastewater facilities to meet certain design specifications, while plant supervisors and other operators are required to be certified at a level that corresponds to the plant's size and complexity. Approximately 232 miles of waters assigned specific designated uses are on the 2018 303(d) List as a result of discharges from wastewater treatment facilities. For additional information on the types of regulated discharges and available permits, please see the Department's website at <http://www.dnr.mo.gov/env/wpp/permits/index.html>.

Concentrated animal feeding operations (CAFOs) in Missouri are required to be designed, constructed, operated and maintained as "no discharge" facilities. All wastewater produced is land-applied rather than being treated and released to streams. Permit requirements include development and implementation of a nutrient management plan which contains a strategy for the onsite utilization of BMPs. There are approximately 855 permitted CAFOs in Missouri, and over 95 percent are managed for hog and poultry production. For more information on CAFOs, please see the Department's website at <http://www.dnr.mo.gov/env/wpp/cafo/>.

The Department issues land disturbance permits to control stormwater runoff from disturbed sites that comprise an area of one acre or more. Land disturbance permits require the use of BMPs to prevent the migration of silt and sediment into surface waters. A stormwater pollution prevention plan must also be prepared prior to issuance of any permit. Some activities that commonly require

land disturbance permits include housing or building construction, road and dam construction, and utility pipelines. For more information on land disturbance permits, please see the Department's website at <http://www.dnr.mo.gov/env/wpp/stormwater/sw-land-disturb-permits.htm>.

The discharge of stormwater runoff transported through Municipal Separate Storm Sewer Systems (MS4s) is another regulated activity. Separate storm sewer systems include any method of conveying stormwater including streets, ditches, swales, or any man-made structure that directs flow. There are 164 identified MS4s in Missouri, and each one is required to develop and implement a stormwater management program to prevent and reduce any contamination of surface waters and prevent illegal discharges. The stormwater management plan includes six minimum control measures: (1) public education and outreach; (2) a process for public involvement and participation; (3) illicit discharge detection and elimination; (4) construction site stormwater runoff control; (5) post-construction stormwater management; and, (6) pollution prevention/good housekeeping for municipal operations. For additional information regarding stormwater regulations, please see the Department's website at <http://www.dnr.mo.gov/env/wpp/stormwater/index.html>.

Nonpoint Source Pollution Control

Nonpoint source (NPS) pollution comes from many diffuse sources and is defined as the transport of natural and man-made pollutants by rainfall or snowmelt, moving over and through the land surface and entering lakes, rivers, streams, wetlands or groundwater. Some common sources of NPS pollution include row crops and agricultural fields, road surfaces and parking lots, septic systems and underground storage tanks. In Missouri, significant contributors of NPS pollution include agricultural land use, urban areas, and abandoned mines. The Department takes two general approaches to managing NPS pollution, one that is volunteer-based and offers monetary incentives and grants, and another that is regulation-focused.

Many NPSs may be addressed by the Department's NPS Management Program. This program engages concerned citizen organizations, landowners, federal, state and local governments, as well as universities and other stakeholders to implement NPS control practices and monitor improvements to water quality and habitat. One priority of the Nonpoint Source Management Program is to provide citizens the knowledge and ability to improve their common land use practices and to protect water quality. The program's mission is "*to achieve aquatic life usage in 50 percent of nonpoint source impaired waters by 2030.*" NPS projects target numerous runoff pollutants (e.g., sediment, fertilizers, pesticides, and animal waste) and seek to improve aquatic habitat problems by stabilizing stream banks, installing grade control structures, and providing riparian and in-stream cover, among other activities. With the exception of special projects, funded activities are carried out as part of a larger watershed plan to improve specific stream and lake resources. Project funding is provided by the EPA through Section 319(h) of the federal CWA, and supports 60 percent of total project costs. The NPS Program is a key partner of the Natural Resources Conservation Service's (NRCS) Mississippi River Basin Initiative (MRBI) and the recent NRCS-EPA collaborative National Water Quality Initiative. For more information regarding the Department's NPS Management Program, please visit the program's website at <http://www.dnr.mo.gov/env/wpp/nps/index.html>.

The Department's Soil and Water Conservation Program (SWCP) provides financial incentives to landowners for implementing conservation practices that help prevent soil erosion and protect water resources. Under this program, 114 district offices serve residents in each county of the state. The SWCP's Agricultural Nonpoint Source Special Area Land Treatment Program allows district staff to direct technical and financial assistance to property owners of agricultural lands

identified as contributing sources of water quality impairments. SWCP also administers a cost-share program to help fund up to 75 percent of the estimated cost for certified conservation practices. In addition, SWCP is a contributing partner of the Mississippi River Basin Healthy Watersheds Initiative (MRBI), a 12-state effort addressing nutrient loading in the Mississippi River Basin. SWCP's primary funding source comes from a one-tenth-of-one-percent parks, soils, and water sales tax that is shared with the Division of State Parks. Please visit the SWCP website for more information at <http://www.dnr.mo.gov/env/swcp/index.html>.

While general NPS pollution is not formally regulated, there are instances of several different types of NPSs falling under a form of water pollution control. As noted earlier, permits are issued to control stormwater runoff from land disturbance activities of an acre or more, as well as for certain industries like biodiesel manufacturers and agrichemical producers. Some additional activities permitted by the state include clay, rock, and mineral mining, abandoned mine land reclamation, land application of human and animal wastewater, and underground petroleum storage. Construction, placement, dredging and filling, or general earth moving within a wetland or waterbody requires a 401 certification from the Department and 404 permit from the United States Army Corps of Engineers (USACE) (<http://www.dnr.mo.gov/env/wpp/401/>). Single family residential wastewater systems, septic systems, which are known nonpoint sources of pollution fall under the jurisdiction and responsibility of the Missouri Department of Health and Senior Services.

Total Maximum Daily Load Program

The TMDL program provides the framework for identifying the assimilative capacity of a waterbody with regard to a particular pollutant or condition that may impair designated uses. A TMDL is defined as a calculation of the maximum amount of a pollutant that a water body can assimilate while still meeting water quality standards. TMDLs are required when a water body and pollutant pair(s) is listed on the state's approved 303(d) list, i.e., when the designated use of a water is not being protected. The TMDL computes the sum of all loads from point sources, non-point sources, and background conditions. A portion of the load capacity is usually allocated to an explicit margin of safety to account for uncertainties in scientific and technical aspects of water quality in natural systems. Some TMDLs may reserve a portion of the assimilative capacity for anticipated growth in the watershed. Recently, the Department began developing implementation plans to accompany TMDLs; these plans will serve as guidance to watershed managers and landowners to protect water quality through the application of demonstrated best management practices.

Since 1999, the Department and EPA have developed 122 TMDL documents and permits in lieu of TMDLs. In some cases, TMDL documents contain multiple TMDLs to address each water body and pollutant pair. There are currently 12 TMDLs that are under various stages of development. Additional information regarding the TMDL program can be found at <http://www.dnr.mo.gov/env/wpp/tmdl/>.

Watershed Based Activities

In 2012, the Department adopted a watershed-based management framework for managing the state's water resources and integrated activities. Managing waters using a watershed approach requires the Department to synchronize activities occurring in a watershed, including: monitoring, assessment, planning, permitting, modeling, conservation and BMPs, and other Department activities. The watershed-based framework overall is a strategy for streamlining and coordinating watershed activities and addressing aquatic resource issues more effectively. The Department has completed watershed summaries for 14 of 66 watersheds. Additional information regarding Missouri watersheds may be found at <http://dnr.mo.gov/omw/>.

B.4. Cost/Benefit Assessment

Section 305(b) requires the state to report an estimate of economic and social costs and benefits required to realize objectives of the CWA. Cost information pertaining to water quality improvement and protection efforts is difficult to calculate exactly, but can be estimated to some degree. While the Department tracks its own programmatic costs, those representatives of municipal, private, and industrial treatment facility operations, and in some cases, the implementation of BMPs, are typically not readily available. Economic benefits, in monetary terms, resulting from water protection efforts are even more difficult to calculate. An overview of the amount of funding the Department spends on various aspects of water pollution control and prevention is provided in the following paragraphs.

The Department spends an average of \$1.2 million on the USGS ambient water quality monitoring network each year. Annual costs for permit issuance averaged approximately \$2.96 million for fiscal years 2014 and 2015. On average, approximately \$7.6 million is spent each year for other facets of water pollution control and administrative support.

Another significant expense includes grants aimed at improving water quality. The Department awards funding provided by the EPA under Section 319 of the CWA for projects that address NPSs of pollution, and approximately \$3.9 and \$3.8 million was spent on NPS projects in state fiscal years (SFYs) 2014 and 2015, respectively. Approximately \$200,000 is awarded annually for planning such projects.

Through the Department's SWCP, an average of \$24.1 million each year is distributed directly to landowners to address agricultural NPS pollution and to conserve and protect the quality of water resources in agricultural landscapes. Over FFYs 2014 to 2015, a total of \$48.3 million was spent on SWCP conservation practices aimed at reducing soil runoff from farmland. Conservation practices have focused on managing animal waste, livestock grazing, irrigation, nutrients and pests, protecting sensitive areas and reducing erosion. Over the life of these conservation practices (i.e. generally 10 years), it's estimated that 4.3 million tons of soil will be protected.

Missouri's Clean Water State Revolving Fund (CWSRF) makes low interest loans available to eligible recipients for designing and constructing publicly-owned wastewater systems and other eligible projects including, but not limited to, stormwater infrastructure, non-point source projects, and water conservation or reuse. During the 2015 reporting period, eight direct loans and four grants were awarded for a total of \$140,720,829 in CWSRF binding commitments. During the 2016 reporting period, nine direct loans and six grants were awarded for a total of \$127,337,870 in CWSRF binding commitments. Funding for the CWSRF is provided by the EPA with matching funds from the state of Missouri. As of September 30, 2016, the SRF's cumulative binding commitments have totaled \$2,730,084,088 resulting in estimated interest savings for Missouri communities of \$908,360,761 as compared to conventional loans.

The Department's Public Drinking Water Branch operates a Source Water Protection Program (SWPP) that is designed to keep drinking water safe for Missouri's residents. The SWPP operates under a voluntary basis to provide public water suppliers with opportunities to protect drinking water that may be threatened by potential contaminants such as pesticides, other hazardous chemicals, stormwater runoff, and waste disposal sites and septic tanks. Funding activities primarily include wellhead protection and capacity development. Costs associated with implementing SWPP activities are generally funded by drinking water SRF set aside monies.

Looking ahead, the Natural Resource Damages (NRD) program, based primarily upon authority vested in the federal “Superfund” law, is responsible for assessing injuries to and restoring natural resources that have been impacted by environmental hazards. The Department’s NRD staff, together with federal trustees such as the United States Fish and Wildlife Service (USFWS) and United States Forest Service (USFS), has reached settlements totaling approximately \$70 million to restore impacted natural resources and the services they provide. Natural resource damage assessment and restoration settlements were largely the result of impacts from heavy metal mining in southeast and southwest Missouri. Two regional restoration plans, which guide restoration activities, have been developed to date, including one for the Southeast Missouri Ozarks Lead Mining District and another for the Missouri portion of the Tri-State Mining District located on the Springfield Plateau. The trustees are actively funding restoration projects in these regions to ameliorate the negative impacts of heavy metals on natural resources.

To maximize efficiency, the Department routinely coordinates its monitoring activities to avoid overlap with other agencies and to provide and receive interagency input on monitoring study design. Program coordination between Missouri and Arkansas is one specific example. Both states entered into a Memorandum of Agreement on November 2008 with the goal of enhancing and promoting cooperation among resource management agencies to address water quality and quantity issues involving surface and ground water resources shared between the two states.

Water quality is an essential prerequisite for quality living in Missouri. The economic benefits of clean water, while difficult to quantify, include: opportunities for water-based recreation such as canoeing, swimming and quality sport fishing; the ability to safely incorporate fish into one’s diet; restored stream environments; aquatic ecosystems with abundant and diverse animal and plant life; and access to quality drinking water with reduced financial burden on those that treat water. The Department’s water protection efforts yield economic benefits far-reaching in scope, helping to insure a prosperous outlook for future generations of Missourians.

B.5. Special State Concerns and Recommendations

Missouri has accomplished significant advances in environmental quality due to its water protection programs. Municipal and industrial wastewater discharged to state waters is not permitted without consideration given to the potential impacts to receiving waters. Improved forestry and agriculture practices have reduced polluted runoff. The same conservation practices have helped preserve farmland and enhance wildlife habitat. While Missouri waters are certainly cleaner today than 30 or 40 years ago, substantial threats remain. Current major environmental concerns may be divided into categories as described in the following paragraphs.

Agricultural and Urban Land Use as Nonpoint Sources of Pollution

Managing agricultural and urban runoff is an ongoing challenge in Missouri; both sources have substantial influence on the condition of water quality. Cropland runoff may contain large amounts of sediment, nutrients, and pesticides. Pollutant loads from urban runoff include sediment from new development and construction; oil, grease, and other chemicals from automobiles; nutrients and pesticides from commercial and residential lawn management; grass clippings and brush disposal into streams; road salts, and heavy metals. Impervious surfaces such as roadways and roof tops increase water volumes in streams during storm events and lower baseflows during dry periods. This hydrological pattern frequently results in eroded stream banks, widened channels, and impaired habitat. Moreover, impervious surfaces are easily heated by the sun which in turn warms surface runoff and ultimately causes stream temperatures to increase. Changes in water quality and habitat conditions that generally accompany urban and agricultural runoff impair aquatic life and diminish the value of other designated uses.

Department programs that are both regulatory and voluntary have proven effective for managing runoff, but such programs are not available to cover all runoff problems occurring across the state. Additional resources and external support are needed to eliminate the threat of NPS runoff.

Municipal and Industrial Sources

Wastewater treatment facilities and other point source dischargers have a significant impact on water quality. Point sources are subject to NPDES permit requirements; however, pollution incidents still happen occasionally. Failing treatment systems, bypasses, accidental spills, or illicit waste disposal are some types of violations that can occur. Discharges of inorganic nutrients may promote blooms of algal growth in receiving waters. Raw or partially treated sludge releases will degrade aquatic communities as organic matter decomposes and dissolved oxygen removed from the water. Other toxic substances can have more direct effects on aquatic life.

Pharmaceutical and Personal Care Products (PPCPs) include any product used by individuals for personal health or cosmetic reasons, or those used by agribusiness to enhance the growth or health of livestock. Some examples of PPCPs include endocrine disrupting sex hormones, antibiotics, steroids, antidepressants, and various prescription and over-the-counter drugs. Treatment facilities are not equipped to eliminate PPCPs from wastewater as these substances pass through on their way to receiving streams and lakes. While little is known about the impacts of PPCPs on human health, aquatic organisms at any stage in development may be affected. An example of the effect of PPCPs on aquatic biota is the feminization (disruption of normal gonad development and function) of male fish as a result of estrogens being released into the water.

The Department has worked with numerous entities to upgrade wastewater treatment facilities in order to meet water quality standards. While the majority of treatment facilities are in compliance, additional facility upgrades are anticipated. The objective of these upgrades is to further alleviate water quality degradation.

Abandoned Mines

Current mining operations have caused significant changes to water quality. Heavy metals such as lead and zinc may enter streams from smelters, mills, mine water, and tailings ponds. However, abandoned lead-zinc mines and their tailings continue to impact waters after mining activity has ceased for decades. Mines that have been left exposed to the elements may pollute waters via stormwater, erosion, and fugitive dust. Through these same pathways, mines that were properly shutdown after operations, but then reclaimed for another land use, have also polluted the environment.

Missouri's Superfund Program is addressing some of these concerns, but despite such efforts, long-term impacts are expected to remain until additional resources are made available. Monitoring will need to target abandoned mines that are suspected of contributing heavy metals to streams. Similarly, reclaimed mines may need to be inspected from time to time to ensure post closure actions have been maintained. Although new mineral extraction operations would be managed under state permits, areas of the state that are sensitive to disruption are being investigated for mining potential.

Concentrated Animal Feeding Operations

As of December 2017, there were 463 actively permitted Class I CAFOs located in Missouri. These include operations containing at least 1,000 beef cattle, 700 dairy cows, 2,500 large swine, or 100,000 broiler chickens. Facilities that generate large amounts of animal waste and manure have the potential to cause serious water pollution problems. Commercial application of manure on fields is also a growing trend within large-scale agriculture operations. The Department is

concerned by the cumulative impacts of numerous small animal production facilities as well. However, it is no longer issuing letters of approval for smaller facilities, meaning they will be largely unregulated.

Missouri's CAFO laws and regulations are designed to minimize any threats of water pollution and ensure long-term protection for the environment. A series of permits are required per CAFO, including a construction permit, a land disturbance permit, and an operating permit. Additionally, issued permits require a nutrient management plan and the implementation of certain management practices for the land application of animal waste.

Mercury in Fish Tissue

Mercury levels in fish continue to impair fish consumption in Missouri waters. For 2018, totals of 844 stream miles and 27,123 lake acres were listed as impaired for mercury in fish tissue. Waters that have been monitored for long periods have shown that mercury levels in fish tissue have remained relatively stable over the years. Without adequate air pollution control, it is anticipated that future monitoring will detect additional waterbodies with elevated levels of mercury in fish tissue.

The Missouri Department of Health and Senior Services (MDHSS) issues an annual health advisory and guide for safely eating fish. Due to mercury contamination, the MDHSS has issued a statewide advisory for a sensitive population that includes children younger than 13, pregnant women, women of childbearing age and nursing mothers. This group has been advised to limit consumption of walleye, largemouth bass, spotted bass and smallmouth bass greater than 12 inches in length to one meal per month, and all other sport fish to one meal per week. The advisory also includes a limit of one meal per month for white bass greater than 15 inches in Clearwater Lake only. Additional advisories for all consumers due to other contaminants may be found at <http://health.mo.gov/living/environment/fishadvisory/>. In most instances and for most people, the health benefits of eating fish outweigh the potential risks from contaminants. The Department plans to continue monitoring for mercury levels in fish.

Eutrophication

Eutrophication of state waters, particularly the recreationally important large reservoirs, is an ongoing concern. Heavy residential development around portions of these reservoirs can threaten water quality in coves and shoreline areas. The large size of these reservoirs and rugged local topography make the construction of centralized collection and treatment systems for wastewater difficult. Without proper maintenance of lakeside septic systems, nutrient-enriched water can find its way to the lake.

Missouri's water quality standards do not include statewide nutrient criteria, but site-specific criteria have been assigned to a limited set of lakes. Moreover, the imposition of limits on most wastewater discharges to Table Rock Lake has reduced phosphorus levels in the James River arm of that lake. The Department continues to track lake nutrient conditions and offers various programs and grants to help address any issues and concerns. For example, the Department awarded \$1,000,000 to the Upper White River Basin Foundation for the purpose of assisting homeowners with the cost of replacing failing septic systems through a combination of grants and loans through the WPP's Financial Assistance Center.

Groundwater Protection

Additional groundwater protection measures are needed. Missouri has programs in place to register and inspect underground storage tanks and oversee the cleanup of leaking underground storage tank sites. Additional programs address wellhead protection, the sealing of abandoned wells, and the closing of hazardous waste sites. A complete groundwater protection program would also include a groundwater monitoring network accompanied by educational programs for those involved in the application of farm chemicals, transport of hazardous materials, and the general public. Additional information may be found at <http://dnr.mo.gov/env/hwp/>.

Additional Concerns

Beyond the threats and concerns mentioned above, others remain. Fish and macroinvertebrate data from across the state indicate biological communities are impacted by degraded aquatic habitat. Physical alterations of the channel, alterations in stream flow patterns, removal of much or all of the riparian zone, and upland land use changes in the watershed are all significant contributors to this problem. Stream channelization is prevalent in the northern and western Central Plains as well as the Mississippi Alluvial Basin in the southeastern corner of the state. Large-scale channelization projects no longer occur, but smaller projects are still carried out to facilitate urban and residential development. Stream road crossings are an additional source of habitat degradation. Low-water crossings and improperly placed and/or sized culverts, which are frequently encountered across Missouri, create upstream barriers to fish passage and are primary points of habitat fragmentation.

Aquatic nuisance species pose a significant threat to the aquatic resources and economy of Missouri. Several invasive species are already present in some waters of Missouri including the zebra mussel (*Dreissena polymorpha*), Eurasian water milfoil (*Myriophyllum spicatum*), and silver carp (*Hypophthalmichthys molitrix*). Algae commonly known as “rock snot” (*Didymosphenia geminata*) and hydrilla (*Hydrilla verticillata*) have been found in neighboring states and are continuing threats due to human dispersal. MDC developed an Aquatic Nuisance Species Management Plan in February 2007.

Climate change presents additional challenges to the state’s aquatic resources. In the Midwest, coldwater fish species are projected to be replaced by cool water species (Karl *et al.* 2009). While precipitation is projected to increase in winter and spring with intense events occurring more frequently throughout the year, warmer temperatures during summer may increase the likelihood of drought (Karl *et al.* 2009). Resulting changes in stream flow would be more likely to have a negative impact on aquatic habitats and residing organisms. According to Missouri’s Forest Resource Assessment and Strategy (Raeker *et al.* 2010), riparian forests could become more important than ever for protecting stream banks and providing filtering functions under a significantly wetter climate. Previously mentioned aquatic invasive species are projected to benefit under a changing climate as they tend to thrive under a wide range of environmental conditions compared to a narrower range tolerated by native species (Karl *et al.* 2009).

PART C: SURFACE WATER MONITORING AND ASSESSMENT

C.1. Monitoring Program

The overall goal of Missouri’s water quality monitoring program is to provide sufficient data to allow for a water quality assessment of all waters of the state. This goal is achieved by meeting six specific objectives: (1) characterizing background or reference water quality conditions; (2) better understanding daily, flow event and seasonal water quality variations and their underlying processes; (3) characterizing aquatic biological communities and habitats and distinguishing

differences between the impacts of water chemistry and habitat quality; (4) assessing time trends in water quality; (5) characterizing local and regional impacts of point and NPS pollution on water quality, which includes compliance monitoring and development of water quality based permits and TMDL studies; and, (6) supporting development of strategies to return impaired waters to compliance with water quality standards.

Monitoring includes four strategic approaches to meet the six specific objectives mentioned above: (1) fixed station monitoring; (2) intensive and special surveys; (3) screening level monitoring; and (4) probability-based surveys. Missouri's "Surface Water Monitoring Strategy" (MDNR 2013) provides an in-depth discussion of the entire water quality monitoring program and strategy. All monitoring is conducted under approved Quality Assurance Project Plans with the Department's Environmental Services Program (ESP) laboratory. The Department's quality assurance management program was previously approved by EPA.

Fixed Station Monitoring

The fixed station monitoring network is designed to obtain water chemistry, sediment, fish tissue, and biological monitoring sites equitably among major physiographic and land use divisions in the state. Selected sites must meet one of the following two criteria: (1) the site is believed to have water quality representative of many neighboring streams of similar size due to similarity in watershed geology, hydrology and land use, and the absence of any impact from a local point or discrete nonpoint water pollution source, or (2) the site is downstream of a significant point source or localized nonpoint source area. There are five subprogram areas that make up the fixed station network.

1. The Department provides funding for an ambient stream network that includes nearly 70 sites monitored between six to 12 times per year by the USGS for a wide variety of physical, chemical and bacteriological constituents, and six of these sites are also sampled at less frequent intervals for a range of pesticides. Two sites on the Missouri River use sondes to collect continuous water quality data from spring through fall.
2. MDNR chemical monitoring at approximately 58 sites two to 24 times per year for nutrients, major ions, flow, temperature, pH, dissolved oxygen and specific conductance.
3. Lake monitoring consists of two programs, the Statewide Lake Assessment Program and the Lakes of Missouri Volunteer Program. SLAP samples an average of 76 lakes four times each summer for nutrients, chlorophyll, volatile and nonvolatile solids, and secchi disc depth. LMVP volunteers sample approximately 65 – 70 lakes six to eight times per year for total nitrogen, total phosphorus, chlorophyll a, and secchi disc depth. Multiple sites are sampled on some larger reservoirs. For additional information regarding LMVP, please see this program's website at <http://www.lmvp.org/>.
4. Fish tissue monitoring is conducted to assess the health of aquatic biota as well as the human health risk associated with consuming fish. Fourteen fixed sites are monitored once every two years and samples analyzed by MODNR for mercury, chlordane, and Polychlorinated Biphenyls (PCBs). Whole fish composite samples of either common carp or redear sunfish are analyzed for metals, mercury, cadmium, selenium, several pesticides, and PCBs.

Additional samples are collected from approximately 30 discretionary sites annually. Bottom feeding fish include common carp and sucker species. Piscivorous fish sampled are preferably black bass species, but alternatively include walleye, sauger, northern pike, trout, flathead catfish, and/or blue catfish. Tissue plug samples are collected from bass species and

analyzed for mercury only. Fillet samples (skin off) are collected from the remainder of bottom and non-bottom feeding species. Fillet samples are analyzed for metals, including mercury, cadmium, and selenium; additionally, fillet samples from bottom feeding species are analyzed for a suite of organic compounds, including several pesticides and PCBs.

Outside of Department-based sampling, MDC monitors another 20-40 sites each year that are considered popular sport fisheries. Fish tissue is analyzed for pesticides, PCBs, mercury and other metals. This data is submitted to the Department and is used to assess the human health/fish consumption beneficial use for the waterbody.

5. Routine monitoring is conducted at 10-15 discretionary sites annually to test for sediment contamination. Sediment samples are analyzed for a suite of heavy metals that individually or synergistically are known to be lethal or detrimental to fish, mussels, and other macroinvertebrates.

In addition to sampling activities noted above, the Department's Division of State Parks conducts routine bacterial monitoring of swimming beaches during the recreational season.

Intensive and Special Studies

Intensive and special studies typically involve frequent monitoring of several sites in a small geographic area. These studies are driven by the need for site-specific water quality information. Findings resulting from intensive and special studies may be used to develop water quality based NPDES permit limits, assist with compliance and enforcement activities, or guide resource management. The Department currently conducts several types of intensive and special studies.

- Wasteload Allocation Studies – Assess receiving waters of wastewater treatment facilities to judge compliance with in-stream water quality standards and/or be used to develop water quality based permit limits. Approximately ten wasteload allocation studies are completed annually.
- Toxics Monitoring – Assess receiving waters of coal mining and processing stations, metal mining operations, various industrial and municipal facilities and CAFOs. The need for this type of monitoring varies greatly from year to year, from zero to 30 sites. Sampling frequency depends on the intended use of data.
- Aquatic Invertebrate Biomonitoring – Macroinvertebrate communities are surveyed to evaluate concerns with either point source discharges, discrete NPS areas such as active or abandoned mining sites, or watershed wide NPS problems. Reference sites are sampled periodically as controls to which targeted sites may be compared. Approximately 45-50 sites are sampled each year. Additionally, the Department contracted with the USGS in 2001 to conduct a study of aquatic invertebrate communities on the Missouri River. The study, *Validation of Aquatic Macroinvertebrate Community Endpoints for Assessment of Biological Condition in the Lower Missouri River*, was published in 2005. The Department sees this work as the first of several steps by which it will promote a better understanding of fish and invertebrate communities of large rivers, and ultimately the development of biological criteria for the Missouri and Mississippi rivers.
- Dissolved Oxygen Studies – Continuous monitors (data sondes) are deployed where low dissolved oxygen levels are suspected. Sampling is carried out below selected hydropower

dams with past low dissolved oxygen problems and in other areas where noncompliant discharges are suspected.

- **Stream Modeling Studies** – Physical and chemical characteristics of designated streams are surveyed. Measurements include the following parameters: channel width and depth, water velocity, water temperature, pH, dissolved oxygen, and chemical biological oxygen demand, and ammonia. Such studies are often carried out for wasteload allocation purposes. Sampling occurs as needed, but is usually limited to about two streams each year.
- **Contract Studies** – The Department typically has several active contracts for water quality monitoring at any given time. Most contracts support CWA Section 319 funded watershed projects, but past contractors have completed Use Attainability Analyses (UAAs) as well as simple monitoring projects, specifically in cases where work entailed highly specialized skills and equipment, or when costs or manpower limitations made it practical.

Screening Level Monitoring

Screening level monitoring involves two separate strategies, low flow surveys and volunteer-based water quality monitoring. Both strategies integrate rapid stream assessment protocols that rely on qualitative sampling of stream biota and visual evidence. Additional water chemistry sampling may occur as a result of inspections and complaint investigations.

Low flow surveys are conducted to assess stream condition potentially influenced by wastewater treatment facilities, mining activities, or landfills. These surveys are a rapid and inexpensive method of screening large numbers of streams for obvious water quality problems and determining where more intensive monitoring is needed. Generally, around 100 sites are screened each year.

The Volunteer Water Quality Monitoring (VWQM) Program is a cooperative project between the Department, MDC, and the Conservation Federation of Missouri. This program is a subset of the Missouri Stream Team Program. Since its inception in 1993, 10,392 citizens have attended 717 water quality monitoring workshops held by program staff across the state. This has resulted in the submission of more than 40,403 separate data sheets for 3362 Missouri stream sites. In SFY 2016, volunteers spent approximately 5820 hours in this endeavor and in 2015 volunteers spent 7860 hours collecting water quality data. The value to the state in time spent by volunteers engaged in water quality monitoring was \$140,494 in 2016 and \$158,181 in 2015.

In SFY 2016, there were 208 new stream teams formed and in 2015 there were 177 new teams added. The total number of stream teams has now reached 5676. In 2016, a total of 253 citizens attended the Introductory Level class, while 249 attended the same workshop in 2015. After the Introductory workshop, many volunteers proceeded on to at least one workshop for higher level training. In SFY 2016, 66 citizens attended a Level 1 workshop, and in SFY 2015 there were another 68 attendees for Level 1. The number of volunteers that attended Level 2 workshops in SFY 2016 and 2015 were 23 and 43, respectively. In both 2016 and 2015, one Level 3 audit was held. In 2016, there were five Cooperative Stream Investigation (CSI) advanced monitoring projects initiated involving and training six volunteers; and 2015 saw 2 CSI projects initiated that involved 13 specially trained volunteers who committed to data collection for the 2-year projects.

Each level of training is a prerequisite for the next higher level, as is acceptable data submission. Levels 2, 3, and CSI are accompanied by increasingly higher quality assurance and quality control stringency. Data submitted by volunteers of Level 2 or above may be used by the

Department to establish baselines of water quality condition for particular streams, or to point out potential problems that are in need of further investigation. Level 2 and higher volunteer monitors are required to return for a validation workshop at least every three years in order to ensure their equipment and methods are up to date, and the data they are gathering has a high level of quality assurance. Volunteers may opt to either attend a Level 2 workshop again or attend a special Validation workshop in order to meet validation requirements. In SFY 2016, a total of 33 volunteers updated their validation status: 21 volunteers attended a Validation workshop and an additional 12 attended a Level 2 workshop; in 2015, a total of 38 volunteers updated their validation status: 21 attended a Validation workshop and another 17 attended a Level 2 workshop. In SFYs 2016 and 2015, volunteers submitted 648 sets of macroinvertebrate data, 1759 sets of water chemistry data, 541 sets of visual survey data, 834 sets of stream discharge data, and 195 site selection data sheets. Wastewater, CAFO and drinking water operators have also attended workshops in order to receive operator certification credits. To date, 344 operators have attended stream team trainings.

Level 2 volunteer data, or higher, is screened annually for physical, chemical, and biological parameters. If adequate data indicate water quality concern or a potential issue, then follow up monitoring by the Department is scheduled. CSI level volunteers may be directly utilized for assisting in departmental studies (e.g., watershed planning, TMDL implementation plans, etc.). In order for higher level data to be utilized by the Department for 303(d) and 305(b) screening purposes, there must have been at least five chemical monitoring visits and/or three biological monitoring visits within a four-year period. For additional information regarding the Department's VWQM program, please visit the following websites <http://www.dnr.mo.gov/env/wpp/VWQM.htm> and <http://mostreamteam.org/library.asp>.

Probability-based Sampling

The Department's probability-based sampling is derived from a partnership with the MDC that is formalized in a signed Memorandum of Understanding (MOU). With this MOU, the Department and MDC share various resource management responsibilities through specific programs. It is under MDC's RAM program that the Department's probabilistic-based sampling is carried out (Combes [MDC], pers. comm.). This sampling effort supports MDC and Department trend monitoring as well as CWA Section 305(b) and 303(d) reporting requirements.

MDC's RAM program monitors approximately 70 stream sites annually from third to fifth order streams. From 2004 to 2008, up to 40 sites were randomly sampled from ecological drainage units on a rotating basis. However, in 2010 sampling focused on aquatic sub-regions rather than ecological drainage units. To ensure all regions of the state are monitored effectively, sampling is conducted on a five-year cycle, with two years spent monitoring streams in the Central Plains subregion, two years in the Ozark subregion, and one year in the Mississippi Alluvial Basin subregion (see Figure 1). The first statewide cycle was completed in 2014, with 173 random sites and 24 reference sites sampled. In 2014, the RAM program switched focus to sampling sites for research related to headwater streams and instream flow issues, but will resume probability-based sampling when those research needs are met. The RAM program assesses stream habitat, aquatic invertebrate and fish communities, and water quality at each stream site. Metrics for assessing the biological integrity of fish communities have thus far only been developed for the Ozark and Ozark border streams (Doisy *et al.* 2008). MDC may also report potentially impaired sites to the Department for additional monitoring. The Department is looking to develop a probability-based survey program that may include low flow surveys and fish tissue contaminants in order to support statewide waterbody assessments.

Monitoring Program Evaluation

The above components to the Department's water quality monitoring program describe the approach for a comprehensive assessment of state waters. Additional elements of the program such as core and supplemental indicators, quality assurance, data management, data analysis and assessment, reporting, and general support and infrastructure are discussed in "A Proposal For A Water Quality Monitoring Strategy For Missouri." (MDNR 2013).

Monitoring has generally addressed critical point source assessments as needed and has adequately characterized regional water quality unimpaired by point source discharges. However, the state's information needs have considerably increased with the advent of large CAFOs, concern over eutrophication of Missouri's lakes and reservoirs, and continuing and expanding urban development, as well as other issues. Of the 115,772 total assessed classified stream miles, 7.67 percent of stream miles were considered monitored (i.e., recent [2009-2016] data were available), whereas 92.3 percent were evaluated despite the lack of recent data. Information gaps and data needs are highlighted in "A Proposal For A Water Quality Monitoring Strategy for Missouri". Among the major monitoring needs identified in this strategy are: (1) the ecological characterization of the Mississippi, Missouri, and other large rivers; (2) the inventory, monitoring, and assessment of the state's wetlands; (3) bacterial monitoring of large reservoirs and biological criteria development for small reservoirs and lakes; (4) screening level surveys for intermittent streams; and (5) additional chemical monitoring of small wadeable streams.

Data Acquisition and Information Sharing

The Department retrieves a large amount of raw data from the USGS and other state, federal, and municipal sources. These data, along with the Department's, are imported to and maintained in the Department's Water Quality Assessment (WQA) database. Data include information pertaining on water chemistry, bacterial concentrations, sediment toxicity, fish tissue contaminants, and fish and invertebrate communities. The WQA database is available to the public online at http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do.

Missouri uses the internet-based WQA system for tracking and reporting water body use attainment information. The stream and lake network of the state, water quality standards information, and locations of permitted wastewater discharges and other potential pollutant sources can all be viewed within a Geographic Information System (GIS) (ArcView) environment. The Department has developed an interactive map viewer and query tool for public use that displays a range of geographic information and is available at www.dnr.mo.gov/internetmapviewer/.

ESP has developed a bioassessment database that provides access to raw data and summarized statistics for all macroinvertebrate sampling it has completed. This database is typically updated following each season of sampling and the most recent version is available to the public online at <http://dnr.mo.gov/env/esp/Bioassessment/index.html>.

The Department has a variety of additional information regarding water quality and conservation programs in the state on its website at www.dnr.mo.gov/water.htm. Some of the available information includes current and proposed NPDES permits, Missouri's water quality standards and the latest LMD, a list of impaired waters and TMDLs, and opportunities for water resource conservation and grant opportunities.

Access to the Department's water quality data is relatively straightforward using online tools. Should additional assistance be needed, general requests for water quality information may be made by calling 1-800-361-4827. Official requests for specific information can be made by

submitting an online request form found at <http://www.dnr.mo.gov/sunshinerequests.htm>. Specific requests that cannot be easily accommodated by the online public database may require the Department to search published reports or water quality data files. If the report or data was generated by the Department, it can be sent to the requestor through electronic mail or regular mail (a hard copy for small reports and data files, or compact disks for larger data files). If the report or data file did not originate with the Department, the request may be passed on to the organization that published the report or data. The requestor is welcome to visit the Department office at 1101 Riverside Dr. in Jefferson City and view files directly.

Requests to view water quality data files, should be sent to:

Missouri Department of Natural Resources
Water Protection Program
ATTN: Mr. Robert Voss
P.O. Box 176
Jefferson City, MO 65102-0176
Phone: 573-522-4505
E-mail: robert.voss@dnr.mo.gov

C.2. Assessment Methodology

Water quality is judged by its conformance with Missouri's water quality standards. This section describes procedures used by the Department to rate the quality of Missouri's waters under this approach, which includes an explanation of the types of data used to determine designated use attainment, how that data is used, and how findings are reported. The assessment methodology is the process the Department uses for meeting requirements of CWA Sections 305(b) and 303(d), and it is the basis for summary tables and appendices provided later in this document.

Information Used to Determine Designated Use Attainment

To determine whether or not each designated use is supported, waterbody-specific monitoring data and other relevant information are reviewed against applicable criteria. Monitoring data generated under the four strategic monitoring approaches mentioned in Section C.1. are key elements analyzed in the assessment process. The Department also utilizes data from many external sources that are monitoring for similar purposes and are determined to produce data of acceptable quality. Federal agencies collecting such data include USGS, EPA, USFS, USFWS, USACE, and the National Park Service. Other contributors of data include resource agencies from the neighboring states of Illinois, Iowa, Kansas, Arkansas, and Oklahoma; several municipal entities; selected projects from graduate level researchers; MDC fish kill and pollution investigation reports; county public health Departments; and, data collected by wastewater dischargers as a condition of their discharge permits (although this data is not used for 303(d) listing purposes). For a complete list of data types and sources, please see Missouri's 2018 LMD, *Methodology for the Development of the 2018 Section 303(d) List in Missouri* (Appendix A).

Water Body Segments

Tables G and H of Missouri's Water Quality Standards published in 10 CSR 20-7.031 contain classifications and use designations for all classified lakes and streams. Each individual waterbody listing in Tables G and H is considered an assessment unit. For each lake in Table G there is only one listing unit. For streams however, single systems may receive multiple classifications according to the character of their natural flow regime (e.g., permanent flow vs. intermittent flow); thus, there may be multiple listings or assessment units in Table H for any given stream or river. For the Mississippi River, water body segments reflect an interstate MOU between five states (Missouri, Illinois, Iowa, Wisconsin, and Minnesota) signed in September,

2003 (UMRBA 2003). The purpose of the MOU is to enhance coordination of water quality assessments and management decisions on the Upper Mississippi River, segmentation points are as follows: Des Moines River-Lock and Dam 21-Cuivre River-Missouri River-Kaskaskia River-Ohio River. Results of UAAs and CWC rulings have affected the designation of recreational uses on the Mississippi River, from the Ohio River to the Missouri River, resulting in further sub-segmentation. Both specific and general criteria may be applied to classified waters of the state. Unclassified waters are usually assessed against general (narrative) criteria and a subset of specific criteria commonly associated with acute toxicity to aquatic life. There are less available data on unclassified waters, and except for 15 streams and lakes, these waters are normally not reported for 305(b) and 303(d) purposes.

Waterbodies are generally assessed individually. For each waterbody, all available data of acceptable quality is reviewed and assessed. That assessment may then be extrapolated to the entire spatial extent of that classified segment. However, the final extent of the assessment may be adjusted to account for significant influences of point source discharges, substantial changes in land use and stream characteristics, and significant hydrologic and channel modifications. In order to adjust the final extent of an assessment, multiple sample points are needed. Occasionally, this method results in assessments that are shorter than the full spatial extent of the classified water body.

C.2.1. Determining Designated Use Attainments

Unique sets of criteria are used to protect specific designated uses assigned to individual waters. Protective criteria include a range of physical, chemical and biological parameters. This means that in order to determine a level of attainment for a designated use, certain types of data must be collected to compare to those protective criteria. Assessing most designated uses involves analyzing multiple parameters, but in some cases, exceeding a single criterion is enough evidence to assess a use as impaired. All classified waters of the state, including large public lakes, are designated to be protected for whole body and/or secondary contact recreation, protection of aquatic life, fish consumption by humans, and livestock and wildlife watering. A subset of these waters is protected for drinking water supply, irrigation and industrial process, and use as cooling water for industrial processes. This section describes how data and information are used by the Department to assess each of these designated uses. For each classified water body, and for each applicable designated use to that water body, Department assessments will be in one of four categories:

- 1) designated use is fully attained;
- 2) designated use is not attained;
- 3) designated use not assessed due to an insufficient data; or
- 4) designated use not assessed.

Generally, a water body use assessment of “fully attained” suggests water quality is fair to excellent, whereas an assessment of “not attained” indicates poor water quality. To what extent resource quality is impacted depends on the degree to which the use is not attained. Waters with at least one designated use assessed as “not attained” are considered impaired. When possible, potential or known causes and sources of the impairment are described.

To make a determination of “fully attained” or “not attained,” data from the previous seven years are generally used. In some cases, however, older data are used when they are believed to be representative of present day conditions.

For complete assessment methodology details please see Missouri's 2018 LMD, *Methodology for the Development of the 2018 Section 303(d) List in Missouri* (Appendix A). The 2018 LMD lists all data that may be used for performing water quality based assessments and the applicable statistical methods for interpreting Missouri's water quality standards. Prior to each listing cycle, the LMD goes through a stakeholder input and review process where it can be revised. Development of the 2018 Section 303(d) List and Section 305(b) report was based exclusively on the 2018 LMD. The 2018 LMD and proposed 2020 LMD may also be viewed at <http://dnr.mo.gov/env/wpp/waterquality/303d/303d.htm>.

Statistical Considerations

For designated use assessment methods, a specific set of statistical procedures are used to determine if exceedances resulting in non-attainment warrant a 303(d) listing. Table B-1 in the 2018 LMD lists all statistical considerations and analytical tools the Department uses for listing waters as impaired. For each analytical tool, a specific decision rule and test procedure is provided. Procedures outlined in the LMD are based on data that meet quality assurance and control standards.

Additional Approaches for Determining Designated Use Attainment

While specific designated use assessment procedures are contained in the LMD, there are several approaches that may be applied to all designated uses. Designated use protection may be accomplished in the absence of data, if the stream being assessed has similar land use and geology as a stream that has already received a water quality assessment. In such cases, the same rating must be applied to the stream being assessed, and this information may only be used for 305(b) reporting, not 303(d) listing. Additionally, where models or other dilution calculations indicate noncompliance with allowable pollutant levels, waters may be added to Category 3B (See section C.2.2. *Water Body Assignment Categories*) and considered a high priority for water quality monitoring. For assessing narrative criteria for all designated uses, data types that are quantifiable can be used. Full attainment with water quality standards is achieved when the stream appearance is typical of reference or control streams in that region of the state. For example, if water color measured using the platinum-cobalt method is significantly higher than an applicable reference stream, the water body would be judged to be in non-attainment of water quality standards.

The Department uses its best professional judgment for interpreting data that has been influenced by abnormal weather patterns and/or situations that complicate appropriate interpretation of the data. In some cases, this means data that would normally be adequate to assess a use is actually determined to be inadequate, and additional sampling is required to ensure a confident assessment.

C.2.2. Water Body Assignment Categories

Once all attainment decisions have been made for a given water body, it is then categorized according to a degree of compliance with water quality standards. The Department utilizes a five part category system which is helpful for reporting attainment of applicable water quality standards, and in the development of monitoring strategies that respond to resource issues identified in the assessment. The five part categorization process is summarized below.

Category 1: All designated uses are fully attained.

Category 2: Available data indicate that some, but not all, of the designated uses are fully attained.

Subcategory 2A: Available data suggest compliance with Missouri's Water Quality Standards. No impairment is suspected.

Subcategory 2B: Some available data suggest noncompliance with Missouri's Water Quality Standards. Impairment is suspected.

Category 3: There are insufficient data and/or information to assess any designated uses.

Subcategory 3A: Available data suggest compliance with Missouri's Water Quality Standards. No impairment suspected.

Subcategory 3B: Available data suggest noncompliance with Missouri's Water Quality Standards. Impairment is suspected.

Category 4: Available data indicate that at least one designated use is not attained, but a TMDL study is not needed.

Subcategory 4A: Any portion of the water is in non-attainment with state Water Quality Standards due to one or more discrete pollutants, and EPA has approved a TMDL.

Subcategory 4B: Any portion of the water is in non-attainment with state Water Quality Standards due to one or more discrete pollutants, and pollution control requirements (i.e., water quality based permits and/or voluntary watershed control plans) have been issued that are expected to adequately address the pollutant(s) causing the impairment.

Subcategory 4C: Any portion of the water is in non-attainment with state Water Quality Standards and a discrete pollutant(s) or other property of the water does not cause the impairment.

Category 5: At least one discrete pollutant has caused non-attainment with Missouri's Water Quality Standards, and the water does not meet the qualifications for listing as either Category 4A, 4B, or 4C. Category 5 waters are those that are placed on the state's 303(d) list.

For 303(d) assessment purposes, each data type (e.g., bacterial, toxic chemical, bioassessment) undergoes a particular statistical treatment to determine compliance with water quality standards.

The Department uses a weight of evidence approach for assessing narrative criteria with numeric thresholds to determine the existence or likelihood of an impairment and the appropriateness of proposing a listing based on narrative criteria. For Tier Three waters, which includes outstanding state and national waters, no level of water quality degradation is allowed; therefore, assessment of these waters will generally compare current data to either historical data or data from segments that support water quality conditions that existed at the time the state's antidegradation rule was promulgated (April 20, 2007). Based upon earlier guidance from EPA, the Department uses a burden-of-proof approach in its hypothesis testing that places emphasis on the null hypothesis. In other words, there must be very convincing data to accept the alternative hypothesis (that the waterbody is impaired).

C.2.3. De-listing Impaired Waters

Several factors may lead to removing a water body from the Section 303(d) list. Removal may occur when a TMDL study addressing all pollutant pairs for a given waterbody has been completed and approved. In situations where an impairment is due solely to a permitted facility, it may be possible to revise the facility's permit to meet the targeted water quality criteria, this is known as a Permit in Lieu of TMDL. Waters that recover from pollution may be de-listed once water quality is assessed as meeting water quality criteria. Analytical tools used for de-listing purposes are described in Missouri's 2018 LMD (see Appendix A). Waters can also be removed as a result of finding errors in the original assessment or listing.

C.2.4. Changes to the 2016 Listing Methodology Document

Noted earlier, the LMD may be revised every even numbered year, undergoing the same review and approval schedule as that required for the Section 303(d) list. There were several updates made to the 2016 LMD. The 2018 LMD incorporates revisions related to reformatting and consolidation of information, along with clarifying statements or information relating to biological assessments, and minor corrections to tables. Additional updates were made as a result of discussions from the Biological Assessment Workgroup meeting and public comments. Below is a summary of those revisions, please see the 2018 LMD for exact details related to each change.

- Additional wording was added to Data Code Three to include additional information for the minimum number of studies needed for aquatic assemblages.
- Under the Weight of Evidence Approach, missing wording that was previously included in the approved 2016 LMD was added back to the 2018 LMD. Also, additional wording of examples of other relevant environmental data might include “physical and chemical” data.
- Under Aquatic Macroinvertebrate Community Data, clarification was added to state the Department conducts aquatic macroinvertebrate assessments.
- A map of Missouri’s Ecological Drainage Units and Biological Reference Locations were added.
- Examples of migration barriers were included.
- Protection of Aquatic Life—dissolved oxygen. An additional statement was added to the note column to clarify only continuous (e.g. sonde) data with a quality rating of excellent or good will be used for assessments.
- Protection of Aquatic Life use for Toxic Chemicals. The explanation of how hardness based metals would be assessed was moved to the note column.
- Protection of Aquatic Life; Biological Aquatic Macroinvertebrates sampled by DNR Protocol. For clarification, reference to Table I of the Water Quality Standards was added.

C.3. Assessment Results

This section is a summary of the Department’s surface water assessments for the 2018 assessment cycle. Included in this section is the allocation of designated uses among classified waters, assessment results per monitored and evaluated waters, summary of lake trophic conditions and water quality trends, results of the five-part categorization of surface waters and probability based surveys, the Section 303(d) list, and designated use support summaries.

In Tables G and H of Missouri’s Water Quality Standards, all classified lakes and stream segments are identified. Classified waters are designated for recreation, aquatic life and fish consumption, and livestock and wildlife watering, with some waters receiving additional designations as described earlier. Table 2 below, summarizes designated uses allocated among classified waters in the state.

Table 2. Allocation of designated uses among Missouri’s classified waters.

Designated Use	Stream miles	Percent of Total	Lake acres	Percent of Total
----------------	--------------	------------------	------------	------------------

Protection of Aquatic Life	115,772	100	363,653	100
Warm-Water Fishery	112,140	97	316,427	87
Cool-Water Fishery	3,273	3	0	0
Cold-Water Fishery	359	<1	47,226	13
Human Health Protection – Fish Consumption	115,772	100	363,653	100
Whole Body Contact Recreation – A	6,269	5	302,613	83
Whole Body Contact Recreation – B	108,855	94	61,040	17
Secondary Contact Recreation	115,772	100	363,653	100
Livestock and Wildlife Watering	115,772	100	363,653	100
Drinking Water Supply	3,551	3	122,363	34
Industrial	1,683	1	6,519	2
Irrigation	115,772	100	363,653	100
Antidegradation				
Outstanding National Resource Waters	202	<1	0	0
Outstanding State Resource Waters	217	<1	270*	<1
Total Classified Waters	115,772		363,653	

*Represents acreage for three marsh wetlands.

Surface Water Monitoring and Assessment Summary

Designated use assessments were developed using Departmental monitoring efforts as described in section C.1., and using data from numerous federal, state, and municipal programs. Due to the state's extensive stream and lake network, it's not feasible to collect adequate data on every classified water body in Missouri. Consequently, only a portion of all classified waters are monitored each assessment cycle. An overview of stream and lake data used for assessment decisions is provided in Tables 3 and 4.

Table 3. Classified stream miles in Missouri that have been monitored, evaluated, and assessed, 2009-2016.

Assessment Result	Monitored (miles)	Evaluated (miles)	Total Assessed
Full Support of Assessed Uses (1, 2A, and 2B)	3,879	1,861	5,740
Impaired for One or More Uses (4A, 4B, 4C, and 5)	4,731	945	5,676
Inadequate Data for Use Assessment (3A and 3B)	275	104,082	--
Total Considered (all categories)	--	--	115,772

Table 4. Classified lake acreages in Missouri that have been monitored, evaluated, and assessed, 2009-2016.

Assessment Result	Monitored (acres)	Evaluated (acres)	Total Assessed
Full Support of Assessed Uses (1, 2A and 2B)	156,703	28,569	185,272
Impaired for One or More Uses (4A, 4B, 4C, and 5)	70,732	1,270	72,002
Inadequate Data for Use Assessment (3A and 3B)	10,214	96,165	--
Total Considered (all categories)	--	--	363,653

Monitored waters include streams and lakes where sufficient water quality data for an assessment have been collected in the past five years. Approximately 7.7 percent of all classified stream miles and 65.4 percent of all classified lake acres are considered to be monitored. Evaluated waters are those waters for which no data are available from the past five years. In these cases, either older data are available, and are considered representative of current conditions; or they have geology and land use similar to nearby monitored waters and their water quality condition is assumed to be similar as well. Totals of 92.3 percent of all classified stream miles and 34.6 percent of all classified lake acres are considered to be evaluated. Unassessed waters are those waters that are not monitored directly and do not have nearby waters with similar geology and land use that are monitored. These represent the classified waters in the state for which an accurate assessment of water quality condition is not possible. Thus, 78.6 percent of classified stream miles and 18.3 percent of classified lake acres are unassessed.

Probability Summary

Data generated by MDC's RAM program served as the primary source of the Department's probability based survey. Specifically, Fish IBI scores were used to determine the percentage of streams that fully support aquatic life use. For this survey, data was restricted to 3rd to 5th order streams in the Ozark subregion that were randomly selected and assessed from 2002-2010 (Figure 1). Only IBI scores with accompanying habitat assessments were used. In cases where poor stream habitat quality existed and the fish community was not fully supported, data was excluded from further analysis. Therefore, resulting fish IBI scores are reflective of water quality condition in the stream. Fish IBI scores greater than 36 indicate aquatic life use was supported, whereas scores of 29-36 indicate a community is suspected to be impaired but is at least partially in attainment, and scores less than 29 suggest the community is impaired and aquatic life use is not supported. Habitat scores were based on 6 separate metrics: (1) substrate quality, (2) channel disturbance, (3) channel volume, (4) channel spatial complexity, (5) fish cover, and (6) tractive force and velocity. Together these six metrics make up the QCPH1 score, which to date, is the best overall indicator of habitat condition as assessed using MDC's RAM protocol. Final selection of Fish IBI scores incorporated MDC staff's best professional judgment to insure surveys were not compromised in any fashion.

IBI scores from 192 fish surveys representing approximately 2,590 miles were used in this summary. Classified streams 3rd to 5th order in size contribute to approximately 9,843 stream miles in the Ozarks. Complete results are provided in Table 5.

Table 5. Probability based support summary of aquatic life use in Ozark Streams.

Project Name	MDC RAM Program
Type of Waterbody	Stream
Target Population	3 rd to 5 th Order, Ozarks Ecoregion
Size of Target Population #sites/miles	192 assessments / 2,589.9 miles
Units of Measurement	Classified stream miles
Designated Use	Aquatic Life
Percent, Miles Attaining	71.4%, 7,048 miles
Percent, Miles Not Attaining	14.1%, 1,437 miles
Percent, Miles Non Response (Suspect)	14.6%, 1,388 miles
Indicator	Biological – Fish IBI
Assessment Date	7/31/2015

Lake Trophic Status

In Missouri, trophic state classification is based on total chlorophyll (ChlT), total nitrogen (TN), total phosphorus (TP) concentrations, and secchi depth (Secchi) measurements. Trophic state is an indicator of a lake's water quality condition in response to nutrient concentrations. The Department utilizes four classes for categorizing lakes by trophic state, including: oligotrophic, mesotrophic, eutrophic, and hypereutrophic. Oligotrophic lakes tend to be low in nutrients and chlorophyll concentrations and have high water clarity, whereas hypereutrophic lakes contain the highest levels of nutrients and total chlorophyll concentrations and reduced clarity. Nutrient levels in lakes are the result of both natural processes and anthropogenic influence. The process by which lakes are enriched with nutrients is known as eutrophication, which is generally accelerated by human activities, particularly in agricultural and urban landscapes.

Chlorophyll is the green pigment present in all plant life and is necessary for photosynthesis. The amount present in a lake depends on the amount of algae and thus, is a good measure of water quality conditions. Total nitrogen is the sum of nitrate and nitrite, ammonia, and organically bound nitrogen. Total phosphorus is comprised of soluble phosphorus and the phosphorus bound to organic and inorganic solids suspended in water. Phosphorus is the limiting nutrient for algae growth in most reservoirs in Missouri.

The four variables described above were used to assess lake trophic classifications using Table 6. Missouri lakes may be grouped into one of four trophic classes including oligotrophic, mesotrophic, eutrophic, and hypereutrophic. The method presently used by the Department to determine trophic status was originally presented in Jones et al. (2008).

Table 6. Lake trophic classifications defined by total chlorophyll, total nitrogen, and total phosphorus concentrations, and secchi depth.

Trophic Class	ChlT (µg/L)	TN (µg/L)	TP (µg/L)	Secchi (meters)
Oligotrophic	< 3	< 350	<10	≥ 2.6
Mesotrophic	3 - 9	≥ 350 - 550	≥ 10 - 25	≥1.3 - < 2.6
Eutrophic	> 9 - 40	≥ 550 - 1200	≥ 25 - 100	≥ 0.45 - < 1.3
Hypereutrophic	> 40	> 1200	>100	< 0.45

In this report, the trophic status summary was updated to account for data collected through 2016. Trophic status was calculated by averaging seasonal values of chlorophyll and total phosphorus. Measurements and samples were taken near the surface, over the deepest part of the lake or just upstream of a reservoir dam, typically three to four times between the beginning of May and the end of August. Summarized results are presented in Table 7. For lake-specific trophic status, please see Appendix D.

There are 3,066 classified reservoirs and lakes included in Missouri's water quality standards. This number excludes 15 waterbodies that are classified as major reservoirs (L2). Approximately ten of the total number are natural lakes occurring within the floodplains of either the Missouri River or the Mississippi River, and the others are man-made reservoirs. Approximately 75 lakes are monitored four or more times during the summer; the monitoring includes analysis of nutrients, suspended solids, and chlorophyll levels, and the measurement of water clarity.

Table 7. Summary of trophic status for Missouri lakes, by natural division.

Trophic Category	Glaciated Plains		Osage Plains		Ozark Border		Ozark Highlands	
	#	acres	#	acres	#	acres	#	acres
Oligotrophic	--	--	--	--	4	93	13	42,322
Mesotrophic	13	1,708	1	--	15	768	16	38,985
Eutrophic	76	44,070	24	58,671	27	1,098	14	76,931
Hypereutrophic	12	1,344	5	1,648	7	416	--	--
Total	101	47,122	30	60,319	53	2,375	43	158,238

Trophic status was summarized for 227 lakes, of which 206 were classified and 21 were unclassified. Only lakes with at least three years of data, with each year consisting of at least 3 samples between May 1 and August 31, were included in the examination. Trophic classes were grouped by natural divisions with distinct combinations of soils, bedrock geology, topography, plant and animal distribution and pre-settlement vegetation (Thom and Wilson 1980). Natural region divisions are very similar to the primary ecological sections of the classification system developed by Nigh and Schroeder (2002). Based on the data parameters described above, the following may be concluded: approximately 42,415 acres (15.8%) of lakes are classified as oligotrophic; 41,461 acres (15.5%) are mesotrophic; 180,770 acres (67.4%) are eutrophic; and 3,408 acres (1.3%) are hypereutrophic.



Figure 2. Natural regions of Missouri (Thom and Wilson 1980).

Trophic status varies considerably between the physiographic regions of the state. Oligotrophic lakes are found predominantly in the Ozark Highlands (Ozarks) where the mostly the forested landscape contributes few nutrients through nonpoint sources. Within the Glaciated and Osage Plains regions where agriculture is a widespread land use, the majority of lakes are in the eutrophic category.

Lake Trends

Lake trends were summarized across physiographic sections (Table 8). Only lakes with at least 20 years of data were evaluated. Nineteen lakes contributed to the Glacial Plains region, 123 to the Ozark Highlands, seven to the Osage Plains and four to the Ozark Border region. Lakes were monitored for secchi disk depth, total phosphorus, total nitrogen, total chlorophyll, non-volatile suspended solids, and volatile suspended solids. Linear regression was used to evaluate each parameter over the monitoring period. A negative slope indicated a decrease over time, whereas a positive slope indicated an increase.

Table 8. Summary of lake trends (slopes in regression equation) for four physiographic regions in Missouri.

Region	Secchi (m/yr)	TP ($\mu\text{g/L/yr}$)	TN ($\mu\text{g/L/yr}$)	ChlT ($\mu\text{g/L/yr}$)	NVSS (mg/L/yr)	VSS (mg/L/yr)
Glaciated Plains (n=19)	-0.003	-0.012	0.142	0.282*	-0.063*	0.033*
Osage Plains (n=7)	0.002	0.406	6.624*	1.101*	-0.182*	0.116*
Ozark Border (n=4)	-0.010*	0.565	7.512*	1.272*	-0.055	0.183*
Ozark Highlands (n=13)	0.021*	-0.265*	-1.636	0.085	-0.027*	0.010

*Denotes significant trends ($p < 0.05$). TP = Total Phosphorus; TN = Total Nitrogen; ChlT = Total Chlorophyll; NVSS = Nonvolatile Suspended Solids; VSS = Volatile Suspended Solids

In the Glaciated Plains, there were significant temporal positive trends for volatile suspended solids and total chlorophyll. In contrast, there was a significant decreasing trend for nonvolatile suspended solids. In the Ozark Highlands region, secchi depth increased over time which corresponds to the significant decrease in total phosphorus exhibited; however, a significant decrease in mineral turbidity presented as nonvolatile suspended solids contrasts this when accompanied by the lack of a significant trend for total chlorophyll concentrations and volatile suspended solids. The Osage Plains and Ozark Border regions had limited trend information available for comparison due to the low number of lakes with sufficient temporal data. However, both regions exhibited a significant increase for total nitrogen, total chlorophyll, and volatile suspended solids while accompanied by a significant decrease for nonvolatile suspended solids. The Ozark Highlands was the only physiographic section to exhibit a significant trend change for phosphorus, which was negative. This significant change could be affected by 6 of the 13 lakes in the Ozark Highlands represented having total phosphorous limits on point sources. In comparison, the Glaciated Plains exhibited no significant temporal trend despite having 5 of the 19 lakes represented with total phosphorus limits and exhibiting a decreasing trend.

Identifying trends in lake water quality can be complicated by seasonal variations, changing climate conditions, and data limitations. Trending may be further complicated by grouping lakes according to physiographic region. For management purposes, lake trends should be tracked on an individual basis. Additional lake information is provided annually by the LMVP and listed on their website at <http://www.lmvp.org/>.

Controlling Pollution in Lakes

In Missouri, the three primary sources of NPS pollution include agriculture lands, urban areas, and to a lesser extent, abandoned mine lands. The Department operates several programs that address water quality and habitat issues facing lakes and reservoirs in the state. While lake pollution may be addressed through regulatory controls, most activities are voluntary. As previously discussed, volunteer activities are typically addressed by the Department's NPS program and SWCP. For more information regarding these programs, please see *Water Pollution Control Activities*, section B.3. of this report.

In-lake management techniques that were previously funded under CWA Section 314 can now be funded under CWA Section 319 in the context of an appropriate NPS project. Several in-lake management techniques are eligible for CWA Section 319 funding, including water level drawdown, shading, and biological controls such as fish or insects, and planting or harvesting of aquatic plants. The Department also works with several watershed groups on a regular basis. At least 77 watershed groups have been formed in Missouri. These groups work to educate and inform landowners of threats to water resources in their area, and promote land management practices that minimize NPS pollution.

The Department samples lake water quality as needed, but general monitoring is primarily conducted under two specific programs, SLAP and LMVP. Together, these programs monitor well over 100 lakes each year. Funding for both SLAP and LMVP is provided under CWA Section 319. Outreach activities are a major component of LMVP.

TMDLs also help reduce pollution in Missouri lakes and reservoirs. The program began in 1999 and as of December 2014, eight studies have been completed for lakes, and were focused

primarily on reducing nonpoint source pollution contributions. Appendix C shows the proposed schedule of future TMDL studies.

Five-Part Categorization of Surface Waters

Results of the five-part categorization of classified surface waters in Missouri are shown in Table 9. Please see Section C.2.2 for category definitions.

Table 9. Amounts (stream mileage and lake acreage) of surface waters assigned to reporting categories.

Water Body Type	Category									Total Class-ified	Total Assessed
	1	2A	2B	3A	3B	4A	4 B	4C	5		
Streams (mi.)	116	4,904	720	102,776	1,580	567	40	401	4,668	115,772	11,416
Lakes (ac.)	0	184,287	985	98,280	8,099	2,276	0	0	69,726	363,653	257,274

Note: Waters in categories 3A and 3B are considered unassessed. Discrepancies between Tables 3 and 9 are due to rounding in stream segment lengths and lake acreages.

Designated Use Support Summary

Designated uses assigned to classified lakes and streams were individually assessed using site specific information, and summarized results are shown in Tables 10 and 11. Each designated use (aquatic life and fish consumption; whole body contact recreation A and B; secondary contact recreation; drinking water supply; industrial process and cooling water; irrigation; and, livestock and wildlife watering) was assessed as either supporting or not supporting. Designated uses were not assessed for waters without existing data, or for waters where existing data were insufficient to accurately conclude a support level. Totals of 11,416 stream miles and 257,274 lake acres were assessed for at least one designated use.

Table 10. Designated use support summary for Missouri's classified streams, 2018.

Designated Use	Full Support	Non-Support	Not Assessed	Total Assessed
Protection of Aquatic Life	8,191 (7.4%)	4,079 (3.7%)	98,831 (88.9%)	111,101
Human Health Protection – Fish Consumption	1,934 (1.8%)	939 (0.09%)	106,766 (97.4%)	109,639
Cool-Water Fishery	2,127 (6.5%)	93 (2.8%)	1,047 (32.0%)	3,267
Cold-Water Fishery	101 (33.8%)	0	198 (66.2%)	299
Whole Body Contact Recreation (A)	1,763 (27.6%)	1,098 (17.2%)	3,533 (55.2%)	6,394
Whole Body Contact Recreation (B)	679 (0.66%)	2,165 (2.1%)	100,349 (97.2%)	103,193
Secondary Contact Recreation	4,451 (40.5%)	658 (0.60%)	104,660 (95.3%)	109,769
Drinking Water Supply	1,818 (51.2%)	0	1,730 (48.8%)	3,548
Industrial	169 (10.3%)	0	1,474 (89.7%)	1,643
Irrigation	1,637 (1.5%)	0	108,003 (98.5%)	109,640
Livestock and Wildlife Watering	2,812 (11.3%)	0	106,824 (88.7%)	109,636

Table 11. Designated use support summary for Missouri's classified lakes, 2018.

Designated Use	Full Support	Non-Support	Not Assessed	Total in State
Protection of Aquatic Life	170,964 (47%)	45,134 (12.4%)	147,555.5 (40.6%)	363,653
Human Health Protection – Fish Consumption	168,228.6 (46.2%)	27,034.2 (7.4%)	168,390.2 (46.3%)	363,653
Whole Body Contact Recreation (A)	224,100.6 (82.9%)	0	46,225.9 (17.1%)	270,326.5
Whole Body Contact Recreation (B)	115 (0.19%)	0	57,897.2 (99.8%)	58,012.2
Secondary Contact Recreation	200,622.6 (55.2%)	0	163,030.4 (44.8%)	363,653
Drinking Water Supply	24,876.1 (18.5%)	44 (0.03%)	109,271.9 (81.4%)	134,192
Irrigation	0	0	363,653 (100%)	363,653
Industrial	0	0	6,959 100%	6,959
Livestock and Wildlife Watering	0	0	363,653 100%	363,653

For each designated use identified as nonsupporting, there may be one to several potential contaminants causing the impairment(s) (Tables 12 and 13). The list of potential contaminants in Tables 12 and 13 is based on waters categorized as 4A, 4B, 4C, and 5. Summarized data are based on site-specific information. When a classified stream segment is identified as impaired, the contaminant(s) is usually considered to impair the entire segment length. However, if available data suggests only a portion of the classified segment is impaired, it is this shorter length which is included in the total impaired stream mileage listed per contaminant, rather than the entire classified segment. When a lake's designated use is impaired, the entire surface area of the lake is considered impaired per contaminant, rather than a smaller portion in closer proximity to the dam outlet where data are collected.

Table 12. Causes of impairments for designated uses assigned to Missouri's classified streams.

Cause/Impairment Type	Impaired Stream Miles	Percent of Total Miles
Bacteria (Fecal Coliform and <i>E. coli</i>)	3921	3.3
Low Dissolved Oxygen	1435	1.2
Mercury in Fish Tissue	844	0.7
Lead	720	0.6
Macroinvertebrate Bioassessments	264	0.2
Fish Bioassessments	369	0.3
Zinc	411	0.4
Cadmium	298	0.3
Sediment/Siltation	152	0.1
Water Temperature	120	0.1
Ammonia (Total and Un-ionized)	57	<0.1
Chloride	71	<0.1
Nickel	41	<0.1
pH	41	<0.1
Unknown Cause(s)	0	0
Polycyclic Aromatic Hydrocarbons	23	<0.1
Biological Indicators of Eutrophication	4	<0.1
Total Dissolved Solids	24	<0.1
Dissolved Oxygen Saturation	33	<0.1
Total Suspended Solids/Bedload	18	<0.1
Copper	9	<0.1
Sulfates	37	<0.1
Chlordane in Fish Tissue	4	<0.1
Total Nitrogen	4	<0.1

Table 13. Causes of impairments for designated uses assigned to Missouri's classified lakes.

Cause/Impairment Type	Impaired Lake Acres	Percent of Total Acres
Chlorophyll (Total and Chlorophyll-a)	86,733	24
Total Nitrogen	84,875	23
Biological Indicators of Eutrophication	83,642	23
Mercury in Fish Tissue	27,131	7.5
Total Phosphorus	2,649	0.7
Dissolved Oxygen Saturation	2,119	0.6
Pesticides (Atrazine)	44	0.01

Contaminants that impair designated uses originate from numerous sources. In some cases, a single source is responsible for providing multiple contaminants to the same water body. Impaired stream miles and lake acreages for each contaminant source are listed in Tables 14 and 15. Summarized information is based on site-specific surveys. While contaminants can usually be identified, monitoring limitations can make it difficult to pinpoint exact sources. Despite these limitations, various pollutant sources have been recognized as causing impairments in Missouri's streams and lakes.

Table 14. Contaminant sources for non-supported designated uses assigned to Missouri's classified streams.

Source Category	Impaired Stream Miles	Percent of Total Miles
Unspecified Nonpoint Source	2,862	2.4
Source Unknown	1,385	1.2
Municipal Point Source	1,125	0.9
Atmospheric Deposition (mercury)	844	0.7
Urban Runoff/Storm Sewers	418	0.4
Industrial Point Source	260	0.2
Agriculture	148	0.1
Permitted Stormwater Discharge	89	0.1
Recreation Pollution Source	62	0.1
Habitat Modification other than Hydromodification	41	<0.1
Natural Conditions	12	<0.1
Road/bridge Runoff	6	<0.1
Rural or Residential Areas	4	<0.1
Upstream Source	0	<0.1
Urban or Municipal Source	2	<0.1
<u>Mining</u>		
Tailings	1,314	1.1
Coal Mining	57	<0.1
Hardrock, subsurface	6	<0.1
<u>Hydrological modification</u>		
Channelization	461	0.4
Dam or Impoundment	102	0.1
Flow Regulation and Modification	29	<0.1

Table 15. Contaminant sources for non-supported designated uses assigned to Missouri's classified lakes.

Source Category	Impaired Lake Acres	Percent of Total Acres
Unspecified Nonpoint Source	131,680	36
Municipal Point Source	125,241	34
Atmospheric Deposition (Mercury)	27,131	7.5
Dam or Impoundment	2,119	0.6
Rural or Residential Areas	371	0.1
Source Unknown	458	0.1
Agriculture	9	<0.1

Section 303(d) Assessment Results – List of Impaired Waters

Under Section 303(d) of the CWA, states are required to develop lists of impaired or threatened waters every two years. An impaired waterbody is defined as having chronic or recurring violations of numeric and/or narrative water quality criteria. Development of the list is based on assessment methods described in section C.2.1. *Determining Designated Use Attainments* and detailed in the 2018 LMD. Missouri's proposed Section 303(d) list is included in Appendix B.

The proposed 2018 Section 303(d) List of impaired waterbodies (approved by the Missouri CWC) includes specific waterbody pollutants, their sources, and estimated impairment size. This proposed list reflects any deletions and additions of water body pollutant pairs since the 2016 Integrated Report. Waterbody pollutant pairs proposed to be removed from Missouri's 2016 Section 303(d) Missouri's are also provided in Appendix B. Waters are typically de-listed when new data shows water quality criteria are no longer exceeded, an assessment method changes, an initial listing error is identified, the EPA established or approved a TMDL, or a permit in lieu of a TMDL was approved by EPA.

In summary, the proposed Section 303(d) List of impaired waters for 2018 includes 470 waterbody pollutant pairs for both classified and unclassified waters. Approximately 5,676 stream miles and 72,002 acres of lakes are categorized as impaired by a specific pollutant. Pollutants most commonly identified include bacteria (165 listings), heavy metals in water or sediment (86), dissolved oxygen (73), and mercury in fish tissue (64). Most common pollutant sources include nonpoint source runoff (agriculture, urban, rural, or unspecified nonpoint sources, mining related impacts, atmospheric deposition, and municipal WWTPs and other point sources.

Sixty-eight pollutant pairs from the 2016 Section 303(d) List were proposed to be removed from the 2018 list. In all cases, de-listing was due to compliance with water quality standards. In a few cases, the return to compliance was attributable to new assessment methods, erroneous listings, or restoration actions. In most cases, however, the recovery reason was unknown. Please see Appendix B for additional details on de-listed waters.

Waterbodies that have been removed from this and previous Section 303(d) lists as a result of an approved TMDL or permit in lieu of a TMDL are listed in Appendix E. These waters were categorized as 4A, 4B, or 4C, and are still considered impaired due to noncompliance with water quality standards. Appendix F lists the waterbodies that are considered potentially impaired, but that do not have sufficient data to conclusively make that assessment.

TMDL Schedule

Under 40 CFR Part 130.7(b), states are required to submit a priority ranking schedule that identifies all waters targeted for TMDL development in the next two years. Each water body-pollutant combination listed in the Section 303(d) list must receive a clear priority ranking. EPA guidance also encourages states to develop TMDLs for each water body-pollutant combinations in a time frame that is no longer than eight to 13 years from the time the water body-pollutant pair was first listed.

The Department is considering a three-step process to address the issue of prioritizing TMDL development. First, a scoring process will be developed that considers the designated uses impaired, the pollutant(s) of concern, and the waterbody order or importance. Second, a screening process to rank watersheds on the basis of their potential to recover rapidly and affordably will be applied. Thirdly, stakeholder involvement will be encouraged. Potential stakeholders include landowners, representatives of the regulated community, and representatives of other state or federal agencies. Appendix C shows the proposed schedule of future TMDL studies.

C.4. Wetlands Programs

Waters of the state identified as wetlands are those that meet criteria in the *United States Army Corps of Engineers Wetlands Delineation Manual 1987*. Missouri's current water quality standards lack designated uses specific to wetlands that are supported by numeric water quality criteria; however, as waters of the state, narrative criteria do apply to wetlands. Of the 624,000 estimated wetland acres in the state, three wetland marshes totaling 270 acres are listed as lakes and are considered Outstanding State Resource Waters. Additional information about wetlands in Missouri may be found at <http://dnr.mo.gov/env/wrc/wetlands.htm>.

Wetlands meeting criteria in the *United States Army Corps of Engineers Wetlands Delineation Manual 1987* and considered jurisdictional are protected under CWA Sections 404 and 401. Persons seeking to alter wetlands through the discharge of "dredge or fill" materials and related impacts (e.g. installing culverts or rip-rap, rerouting streams, wetland fill for development purposes, etc.) must apply for a Section 404 permit with USACE; in conjunction, the applicant must also obtain a Section 401 Water Quality Certification from the Department ensuring water quality standards will not be violated and/or appropriate mitigation steps will be taken when impacts are unavoidable.

The Department's WPP, under direction by the Missouri CWC and EPA, is working to establish water quality standards for wetlands. The WPP has been awarded a Wetland Program Development Grant by EPA with the goal of establishing a set of reference wetlands in Missouri. In the process, this project will develop methods to identify other candidate reference wetlands using onsite water chemistry and biological sampling. Ultimately, it is intended that reference wetland information may be used as the basis for developing wetland water quality standards and for establishing an IBI for wetlands.

The Department's Water Resources Center administers the State Wetlands Conservation Plan, which encourages the protection and restoration of wetlands and provides technical assistance to other agencies involved in wetland issues. With the assistance of other state and federal agencies, and a partnership with University of Missouri, the Department has completed several projects. These include studies assessing urban wetlands, identifying types of wetlands through image analysis, wetland nutrient monitoring, determining the hydrology of Missouri riparian wetlands, and an assessment of specific wetland mitigation sites. Continuous monitoring of wetland hydrology is conducted at six sites in the state.

Numerous state and federal wetland projects have been undertaken to protect and enhance Missouri's wetland resources. Together MDC, USFWS and NRCS have protected more than 260,000 acres of wetlands through easements or purchases, restored more than 43,000 acres, and enhanced more than 41,000 acres in Missouri.

C.5. Public Health Issues

EPA asks states to provide information on public health issues, including information on drinking water supply, whole body contact recreation, and fish consumption advisories. The procedures for determining attainment of each use are provided in section C.2.1, *Determination of Designated Use Attainments*. Please see Tables 10 and 11 for designated use support summaries related to drinking water supply, whole body contact recreation, and fish consumption uses.

Drinking water supply usage is designated for 3,551 stream miles and 122,363 lake acres. This use is not supported in two lakes, Lewistown Lake (Lewis Co., 35 ac.) and Wyaconda Lake (Clark Co., 9 ac.). In both cases, the contaminant is atrazine due to local herbicide applications.

All classified lakes and streams are designated for fish consumption use. For streams, 844 miles are impaired due to contaminants in fish tissue. In 13 of 14 streams, the contaminant is mercury and in a single stream (Blue River, Jackson Co.) the contaminant is chlordane. Forty-four classified lakes covering a total of 27,034 acres are impaired by mercury in fish tissue. Mercury is known to make its way to surface waters through atmospheric deposition; whereas chlordane was previously used as a pesticide and is likely transported to streams during runoff events.

The MDHSS publishes an annual fish advisory and guide for eating fish in state waters. MDHSS's advisory offers guidelines for two populations, all consumers and a sensitive population, which is defined as pregnant women, women of childbearing age, nursing mothers, and children younger than 13. In Missouri, guidelines vary according to water body, fish species and length. Contaminants of concern include mercury, chlordane, lead, and PCBs. For all consumers, recommendations vary from one meal per week to "Do Not Eat" for specific species from certain rivers. The statewide recommendation for the sensitive population is to eat no more than one meal of fish per month. The complete fish advisory guide for 2015 is available in portable document format at <http://health.mo.gov/living/environment/fishadvisory/pdf/fishadvisory.pdf>.

E. coli is sampled at a select set of designated swimming beaches in the state park system on regular basis during the recreational season. Swimming is discouraged when the geometric mean of weekly sample results exceed 190 *E. coli* colonies per 100 ml of water. Sampling results and beach notifications can be viewed online at <http://www.dnr.mo.gov/asp/beaches/index.html>.

PART D. GROUNDWATER MONITORING AND ASSESSMENT

Groundwater resources vary considerably in quantity and quality across Missouri. It's estimated that during normal weather cycles, 500 trillion gallons of drinkable groundwater is stored in Missouri's aquifers (Miller and Vandike 1997). Certain aquifers yield high volumes of quality water, whereas in some areas groundwater yields are low and/or contain water that is too mineralized for consumption. This section provides an overview of significant groundwater resources in the state, groundwater interactions with surface waters, groundwater quality, sources of groundwater contamination, and current monitoring efforts and protection programs.

D.1. Groundwater in Missouri

Approximately 42 percent of Missourians rely on groundwater for drinking water. Groundwater is the primary source of drinking water in the Ozarks and the Southeastern Lowlands for both public and private systems. The cities of St. Joseph, Independence, Columbia, and St. Charles use groundwater from the alluvial aquifer of the Missouri River. In the plains region of the state, many small communities are able to obtain adequate water from shallow alluvial wells near rivers or large creeks, and many individual households still rely on shallow upland aquifers despite small yields.

In the Ozarks, groundwater yields are usually large and of excellent quality, as witnessed by the fact that unlike cities in other areas of the state, many municipalities pump groundwater directly into their water supplies without treatment. However, the geologic character of the Ozarks that supplies it with such an abundance of groundwater, namely its ability to funnel large amounts of rainfall and surface runoff to the groundwater system, can present problems for groundwater quality. This is because much surface water flows directly to groundwater through cracks, fractures or solution cavities in the bedrock, with little or no filtration. Contaminants from leaking septic tanks or storage tanks, or surface waters affected by domestic wastewater, animal feedlots, and other pollution sources can move directly into groundwater through these cavities in the bedrock.

As in the Ozarks, groundwater in the southeast lowlands is abundant and of good quality. Unlike the Ozarks, contaminants are filtered by thick deposits of sand, silt, and clay as they move through the groundwater system. Shallow groundwater wells, however, are subject to the same problems of elevated levels of nitrate or bacteria experienced in the Ozark aquifer and can also have low levels of pesticides. Deep wells are generally unaffected by contaminants.

Shallow groundwater in the plains of northern and western Missouri tends to be somewhat more mineralized and to have taste and odor problems due to high levels of iron and manganese. Like shallow wells in the southeast lowlands, wells in this part of the state can be affected by nitrates, bacteria, or pesticides.

In urban areas, alluvial aquifers of large rivers such as the Missouri and the Meramec which serve water supplies have occasionally been locally contaminated by spills or improper disposal of industrial or commercial chemicals.

D.2. Well Construction and Groundwater Quality

Well construction greatly influences the quality of well water and therefore, state regulations include construction standards for both public and private wells. Public drinking water wells and many private wells are deep, and properly cased and grouted. These wells rarely become contaminated. However, many private wells established prior to the development of construction standards are shallow or not properly cased. These wells can be easily contaminated by septic tanks, feedlots or chemical mixing sites near the well. Studies in Missouri have shown that two-thirds of wells contaminated by pesticides are less than 35 feet deep. The three most common problems in private wells are bacteria, nitrate, and pesticides. Water quality criteria for each of these pollutants can occasionally be exceeded in private wells.

D.3. Major Potable Aquifers in Missouri

Locations of major aquifers providing drinkable water in Missouri are described below.

Unconfined aquifers are those influenced by water table conditions (the pressure at the water table is the atmospheric pressure), and tend to yield greater amounts of water, but are also more

easily contaminated by activities occurring at the land's surface. In confined aquifers, groundwater is overlain by a low permeable geologic material, and groundwater below is under pressure greater than atmospheric pressure alone. Confined aquifers generally recharge more slowly than unconfined aquifers, but are better protected from surface contaminants.

Glacial Till Aquifer

This aquifer covers most of Missouri north of the Missouri River. The glacial till is an unsorted mixture of clay, sand, and gravel, with occasional boulders and lenses of sand or gravel. Loess, fine wind-blown silt deposits four to eight feet in depth, covers the till on the uplands. In some places, the till is underlain by sorted deposits of sand or gravel. Although this aquifer is unconfined, surface water infiltrates very slowly and groundwater yields are very small. In scattered areas, the till has buried old river channels that remain as large sand or gravel deposits that contain much more groundwater than the till. Some households rely on these areas for drinking water, but it is generally inadequate as a source for municipal water supply.

Alluvial Aquifer

Alluvial aquifers are the unconfined aquifers on the floodplains of rivers and are of Quaternary age. In Missouri, the largest of these aquifers lie along the Missouri and Mississippi rivers, reaching their widest extent in the southeast lowlands, where they extend as far as 50 miles west of the Mississippi River. Many small communities north of the Missouri River use alluvial aquifers of nearby streams as their drinking water supply, and the Missouri River alluvium supplies the cities of St. Joseph, Independence, and Columbia and sections of St. Charles County. In the southeast lowlands, most private water supplies and about 45 percent of people served by public water supplies use water from the alluvial aquifer. Agricultural irrigation consumes much more water in this area of Missouri than does domestic water use. All agricultural irrigation water is drawn from the alluvial aquifer.

Wilcox-McNairy Aquifers

These two aquifers lie beneath much of the alluvial aquifer of the southeast lowlands. They are in unconsolidated or loosely consolidated deposits of marine sands and clays of Tertiary and Cretaceous age. Except where the McNairy aquifer outcrops in the Benton Hills and along Crowley's Ridge, these aquifers are confined. They yield abundant amounts of good quality water, and they provide water for 55 percent of people served by public supplies. In the southeastern part of this region, the deeper of these aquifers, the McNairy, becomes too mineralized to be used for drinking water supply. These two aquifers appear to be unaffected by contaminants of human origin.

Ozark-St. Francois Aquifer

This aquifer covers most of the southern and central two-thirds of Missouri. It is composed of dolomites and sandstones of Ordovician and Cambrian age. Most of the aquifer is unconfined. This aquifer is used for almost all public and private drinking water supplies in this area of Missouri. Exceptions would include supplies in the St. Francois Mountains, such as Fredericktown and Ironton, where the aquifer has been lost due to geologic uplift and erosion, and near Springfield, where demand is so heavy that groundwaters are supplemented with water from three large reservoirs and the James River.

Yields and water quality are typically very good, but in many areas, the bedrock is highly weathered, contains many solution cavities, and can transmit contaminated surface waters into the groundwater rapidly with little or no filtration. Where the confined portion of the aquifer is overlain only by the Mississippian limestones of the Springfield aquifer, the confined Ozark aquifer continues westward for 80 miles or more as a potable water supply, serving the

communities of Pittsburg, Kansas and Miami, Oklahoma. However, where it is also overlain by less permeable Pennsylvanian bedrock, the confined Ozark becomes too mineralized for drinking water within 20 to 40 miles.

The unconfined Ozark-St. Francois aquifer is susceptible to contamination from surface sources. Increasing urbanization and increasing numbers of livestock are threats to the integrity of portions of this valuable aquifer.

Springfield Aquifer

This aquifer covers a large portion of southwestern Missouri. It is composed of Mississippian limestones that are highly weathered, particularly in its eastern extent. The aquifer is unconfined and surface water in many areas is readily transmitted to groundwater. Urbanization and livestock production also affect this aquifer. Elevated nitrates and bacterial contamination are common problems in groundwater here.

D.4. Groundwater Contamination, Monitoring, and Protection

Contamination

Major sources of groundwater contamination in Missouri are generally associated with agricultural activities, chemical and waste storage and treatment facilities, industrial and mining processes, and accidental spills. Each contaminant source may lead to one or more contaminants and is typically associated with one or more significant risk factors. Sources of contamination can be prioritized by their contaminants and risk factors, as a result, 10 sources of groundwater contamination are considered priority sources in the state. Please see Table 16 for a list of major sources of groundwater contamination in Missouri, and their related contaminants and associated risk factors.

Table 16. Major sources of groundwater contamination in Missouri.

Contaminant Source	10 Highest Priority Sources (X) ¹	Significant Risk Factors ²	Contaminants ³
Agricultural Activities			
Agricultural chemical facilities			
Animal feedlots			
Drainage wells			
Fertilizer applications	X	A,C,D,E	a
Irrigation practices			
Pesticide applications	X	A,B,C,D,E	b
Storage and Treatment Activities			
Land application	X	A,D,E	a,c
Material stockpiles			
Storage tanks (above ground)			
Storage tanks (underground)	X	A,B,C,D,E	d
Surface impoundments			
Waste piles			
Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills			
Septic systems	X	A,D,E	a,c
Shallow injection wells			
Other			
Hazardous waste generators			
Hazardous waste sites	X	A,B,C,D	b,e,f,g
Industrial facilities	X	A,B,C,E	a,h,i,j
Material transfer operations			
Mining and mine drainage	X	A,E	f
Pipelines and sewer lines			
Salt storage and road salting			
Salt water intrusion	X	C	k
Spills	X	A,B,C,E	b,d,e,h
Transportation of materials			
Urban runoff			

¹Not in order of priority.

² A. Human health or environmental toxicity risk

B. Size of population at risk

C. Location of sources relative to drinking water sources

³a. Nitrate

b. Organic Pesticides

c. Pathogens (Bacteria, Protozoa, Viruses)

d. Petroleum Compounds

e. Halogenated Solvents

f. Metals

D. Number and/or size of contaminant sources

E. Hydrogeologic sensitivity

g. Radionuclides

h. Ammonia

i. Pentachlorophenol

j. Dioxin

k. Salinity/Brine

Monitoring

The Department's Hazardous Waste Program and Public Drinking Water Branch manage activities to protect groundwater and public health. The department's Water Resources Center is responsible for water quantity issues and operates and maintains a network of 168 groundwater level observation wells for monitoring Missouri's aquifers. While the Department does not directly administer a single statewide monitoring program for groundwater quality, such data is collected for specific projects and tracked by both Department programs.

The goal of the Hazardous Waste Program is to protect human health and the environment from threats posed by hazardous wastes. One of this program's primary functions is to oversee cleanup of contaminated sites, which may be addressed by one of the Department's regulatory programs such as the Comprehensive Environmental Response Compensation and Liability Information System, Leaking Underground Storage Tanks, and Resource Conservation and Recovery Act. Additionally, the program's Federal Facilities Section provides oversight and review of investigations, management and remediation of hazardous substances at facilities currently or previously owned or operated by the Department of Defense or Department of Energy. Furthermore, contaminated sites may be subject to regulation if they are one of the National Priorities Listed sites, cleanup involves underground injections into the aquifer, or they reside on state lands. Table 17 is a summary of groundwater contamination and remediation per source type for 2014 and 2015. More information regarding the Hazardous Waste Program may be found at <http://www.dnr.mo.gov/env/hwp/index.html>.

Table 17. Groundwater contamination summary for all aquifers, 2014-2015.

Source Type	Number of sites	Number of sites that are listed and/or have confirmed releases	Number with confirmed groundwater contamination	Contaminants*	Number of site investigations	Number of sites that have been stabilized or have had the source removed	Number of sites with corrective action plans	Number of sites with active remediation	Number of sites with cleanup completed
NPL	23	23	23	1,2,3	-	-	-	-	-
CERCLIS (non-NPL)	28	28	28	1,2,3	-	-	-	-	-
DOD/DOE	308	37	33	1,2,3,4	37	226	244	18	57
LUST	3,201	206	180	3	144	61	-	880	72
RCRA Corrective Action	89	55	51	1,2,3,4	51	39	30	29	17
Underground Injection	27	27	27	1,2,3,4	27	-	27	-	
State Sites	1,050	1,050	525	1,2,3,4	1,036	525	525	49	575

NPL - National Priority List; DOE - Department of Energy ; DOD - Department of Defense; CERCLIS - Comprehensive Environmental Response, Compensation, and Liability Information System; LUST - Leaking Underground Storage Tanks; RCRA - Resource Conservation and Recovery Act.
Underground Injection - includes sites where chemicals were injected into groundwater as part of approved remediation plan.

*Contaminants: 1- VOAs, SVOAs, Solvents, PCBs, Dioxin, PAHs, Herbicides, Pesticides, Metals, Explosives
2- VOAs, PCBs, Pesticides, Dioxin, Metals, Radionuclides, SVOCs, etc.
3- BTEX, TPH, MTBE, PAHs, Metals, SVOA
4- Creosote, Pentachlorophenol, Organic Solvents, Chlorinated Solvents, Petroleum, Asbestos

The WPP's Public Drinking Water Branch ensures all public water systems provide safe drinking water to people. Public water systems utilizing groundwater may test supply wells for compliance purposes. This data is reviewed and stored in the Public Drinking Water Branch's database. In this reporting cycle, groundwater results are presented for 21 counties in southwest Missouri that are underlain by the Springfield Plateau groundwater province, also called the Springfield Aquifer. Taney and Douglas counties were excluded from this summary since only very small portions of each are underlain by the Springfield Plateau groundwater province. Sample parameters were summarized for each public water supply and included nitrate, synthetic organic chemicals (SOCs), and volatile organic chemicals (VOCs). Currently, the Department regulates 30 different SOCs and 21 VOCs. Nitrate and VOC levels were measured at detectable levels at some facilities, however, no exceedances of groundwater standards were observed. Exceedances were determined in accordance with maximum contaminant levels per 10 CSR 60-4.030, 10 CSR 60-1.040 and 10 CSR 60-4.100. Please see Table 18 for a summary of groundwater quality in the Springfield Plateau groundwater province.

Table 18. Groundwater quality sample results reported by public drinking water facilities from 21 counties overlying the Springfield Plateau groundwater province, July 1, 2016 through February 5, 2018.

County	Reporting Facilities	Numbers of Detections			Numbers of Exceedances		
		NO ₃	SOCs	VOCs	NO ₃	SOCs	VOCs
Barry	84	102	0	9	0	0	0
Barton	5	4	7	0	0	0	0
Benton	91	49	0	0	0	0	0
Cedar	30	12	0	5	0	0	0
Christian	43	42	0	7	0	0	0
Cooper	7	3	10	0	0	1	0
Dade	18	7	0	1	0	0	0
Greene	78	58	0	3	0	0	0
Henry	6	7	8	0	0	1	0
Hickory	43	32	0	0	0	0	0
Jasper	37	37	0	0	0	0	0
Johnson	12	8	6	0	0	0	0
Lawrence	33	35	0	2	0	0	0
McDonald	26	16	0	0	0	0	0
Newton	45	48	3	0	0	0	0
Pettis	31	11	0	1	0	0	0
Polk	22	26	0	1	0	0	0
St Clair	16	9	0	0	0	0	0
Stone	225	207	0	17	0	0	0
Vernon	6	7	0	0	0	0	0
Webster	23	36	0	2	0	0	0

While the Water Resources Center focuses on water quantity issues regarding availability and usage, it conducted a statewide screening level survey for pesticides in shallow groundwater wells from 2001 to 2006 (Baumgartner 2006). The purpose of this project was to determine if agricultural pesticides entered groundwater as a result of normal field application. The project focused on four primary pesticides: atrazine, simazine, alachlor, and metolachlor. Samples were collected from 190 wells, of which 186

showed no measurable levels of specific pesticides. Of the four wells that showed some level of pesticide contamination in groundwater, no samples contained concentrations above maximum contaminant levels listed under EPA guidelines at that time.

Groundwater Protection

Different programs within the Department are responsible for certain aspects of groundwater protection. Please see Table 19 for a summary of groundwater protection programs or activities carried out by the state of Missouri. Please visit the Department's website at <http://www.dnr.mo.gov/> for additional information on specific groundwater protection programs.

Table 19. Summary of groundwater protection programs in Missouri.

Program or Activities	Check (X)	Implementation Status	Responsible State Agency
Active SARA Title III Program	X	Fully Established	MDPS/SEMA
Ambient Groundwater Monitoring System		N/A	
Aquifer Mapping and Characterization	X	Continuing Effort	DNR
Aquifer Vulnerability Assessment		N/A	
Comprehensive Data Management System		N/A	
EPA-Endorsed Core Comprehensive State Groundwater Protection Program		N/A	
Groundwater Best Management Practices	X	Continuing Effort	DNR
Groundwater Classification		N/A	
Groundwater Discharge Permits	X	Fully Established	DNR
Groundwater Legislation	X	Developed	DNR
Groundwater-Level Observation Network	X	Fully Established	DNR
Groundwater Monitoring at Sanitary Landfills	X	Fully Established	DNR
Groundwater Quality Standards	X	Fully Established	DNR
Interagency Coordination for Groundwater Protection Initiatives	X	Fully Established	DNR
Nonpoint Source Controls	X	Continuing Effort	DNR
Pesticide State Management Plan	X	Developed	MDA
Pollution Prevention Program	X	Continuing Effort	DNR
Resource Conservation and Recovery Act (RCRA) Primacy	X	Fully Established	DNR
State RCRA Program Incorporating More Stringent Requirements Than RCRA Primacy	X	Fully Established	DNR
State Septic System Regulations	X	Fully Established	MDHSS
State Superfund	X	Fully Established	DNR
Underground Injection Control Program	X	Fully Established	DNR
Underground Storage Tank Installation Requirements	X	Fully Established	DNR
Underground Storage Tank Permit Program		N/A	
Underground Storage Tank Remediation Fund		N/A	
Vulnerability Assessment for Drinking Water/ Wellhead Protection	X	Fully Established	DNR
Well Abandonment Regulations	X	Fully Established	DNR
Wellhead Protection Program (EPA-Approved)	X	Fully Established	DNR
Well Installation Regulations	X	Fully Established	DNR

MDPS/SEMA: Missouri Department of Public Safety, State Emergency Management Agency

MDA: Missouri Department of Agriculture, MDHSS: Missouri Department of Health and Senior Services

PART E. PUBLIC PARTICIPATION

In accordance with federal CWA regulation and Missouri Revised Statute 644.036.5, the Department provides several opportunities for the public to participate in the development of the Section 303(d) list. The LMD receives public review as well and is approved pursuant to 10 CSR 20-7.050. The public comment period for the proposed 2018 Section 303(d) List and 2020 LMD was opened on July 3, 2017 and closed October 13, 2017. Both documents were posted on the Department's Section 303(d) website at <http://dnr.mo.gov/env/wpp/waterquality/303d/303d.htm> throughout the comment period. Assessment worksheets for proposed water body listings were also included on the webpage. During the comment period, two public availability meetings were held at the Lewis and Clark State Office Building in Jefferson City, one on August 24 and another on September 19 with one of Missouri's Clean Water Commission in attendance. Video and audio from the hearing can be found on the CWC's website at commission member present. Additionally, a Clean Water Commission hearing on both the proposed Section 303(d) list and 2020 LMD was held on October 4, 2017. Video and audio from the hearing can be found on the CWC's website at <http://dnr.mo.gov/env/wpp/cwc/index.html>. The public notice was posted in six major newspapers circulated primarily in and around the cities of St. Louis, Kansas City, Springfield, Kirksville, Columbia, and Cape Girardeau.

Summaries of each information session were posted on the Department's Section 303(d) website following each meeting, and have been included with all administrative records submitted with the Section 303(d) list package to EPA. During each meeting, both impaired waterbody listing decisions and the 2020 LMD were reviewed and discussed with members of the 303(d) stakeholder group and others in attendance. The Department responded to all questions and comments received during the public notice period. Responses to public comments regarding the Section 303(d) list are included in Appendix G. Responses to public comments regarding the 2020 LMD will be posted to the Department's Section 303(d) website at a later date. Missouri's Section 303(d) list was approved by the CWC during a public meeting held on October 18, 2018.

REFERENCES

- Baumgartner, S.D. 2006. Results of monitoring shallow groundwater in Missouri for four agricultural pesticides, 2001-2006. Final Report to U.S. EPA Region VII. Missouri Department of Natural Resources - Water Resources Center. 21 pages.
- Doisy, K.E., C.F. Rabeni, M.D. Combes, and R.J. Sarver. 2008. Biological criteria for stream fish communities of Missouri. Final Report to the Environmental Protection Agency. Region 7. Kansas City, Kansas. February 12, 2008.
- Epperson, J.E. 1992. Missouri wetlands: a vanishing resource. Missouri Department of Natural Resources, Division of Geology and Land Survey. 66 pages.
- Jones, J.R., D.V. Obrecht, B.D. Perkins, M.F. Knowlton, A.P. Thorpe, S. Watanabe, and R.R. Bacon. 2008. Nutrients, seston, and transparency of Missouri reservoirs and oxbow lakes: an analysis of regional limnology. *Lake and Reservoir Management* 24:155-180.
- Karl, T.R., J.M. Melillo, and T.C. Peterson. 2009. Global climate change impacts in the United States. United States Global Change Research Program. Cambridge University Press, New York, NY, USA.
- Miller, D.E., and J.E. Vandike. 1997. Missouri state water plan series volume II, groundwater resources of Missouri. Missouri Department of Natural Resources' Division of Geology and Land Survey. Water Resources Report No. 46. 210 pages.
- Missouri Department of Natural Resources. 2014. Proposed methodology for the development of the 2016 section 303(d) List in Missouri. Missouri Department of Natural Resources, Division of Environmental Quality, Water Protection Program. Approved by the Missouri Clean Water Commission. July 9, 2014.
- Missouri Department of Natural Resources. 2013. A proposal for a water quality monitoring strategy for Missouri. Missouri Department of Natural Resources Water Pollution Control Program. Draft Document.
- Nigh, T.A., and W.A. Schroeder. 2002. Atlas of Missouri ecoregions. Missouri Department of Conservation.
- Pflieger, W.L. 1997. The fishes of Missouri. Missouri Department of Conservation. Jefferson City, Missouri.
- Raeker, G., J. Fleming, M. Morris, K. Moser, and T. Treiman. 2010. Missouri's forest resource assessment and strategy. Missouri Department of Conservation and United States Department of Agriculture Forest Service. 222 pages.
- Sowa, S.P., D.D. Diamond, R. Abbitt, G. Annis, T. Gordon, M.E. Morey, G.R. Sorenson, and D. True. 2005. A gap analysis for riverine ecosystems of Missouri. Final Report, Submitted to the USGS National Gap Analysis Program. 1,675 pages.
- Thom, R.H. and J.H. Wilson. 1980. The natural divisions of Missouri. *Transactions of the Missouri Academy of Science*. 14:9-23.
- United States Census Bureau. 2014. State and County Quick Facts website accessed September 21, 2017. <https://www.census.gov/quickfacts/fact/table/MO,US/PST045217>.

APPENDIX A

Methodology for the Development of the 2018 Section 303(d) List

APPENDIX B

2018 Missouri Section 303(d) List of Impaired Waters

APPENDIX C

TMDL Schedule and Section 303(d) Prioritization

APPENDIX D

Lake Specific Trophic Data

APPENDIX E

Other Waters Rated as Impaired and Believed to be Impaired

APPENDIX F

Potentially Impaired Waters

APPENDIX G

Responsiveness Summary

**Methodology for the Development
of the
2018 Section 303(d) List in Missouri
Final April 6, 2016**

Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program



Table of Contents

I. Citation and Requirements	1
A. Citation of Section of Clean Water Act	1
B. U.S. EPA Guidance.....	1
II. The Methodology Document	7
A. Procedures and Methods Used to Collect Water Quality Data.....	7
• Department Monitoring	7
• Coordination with Other Monitoring Efforts in Missouri.....	7
• Existing Monitoring Networks and Programs	7
• Identification of All Existing and Readily Available Water Quality Data Sources	11
• Laboratory Analytical Support	12
B. Sources of Water Quality Data	13
C. Data Quality Considerations	15
• DNR Quality Assurance/Quality Control Program	15
• Other Quality Assurance/Quality Control Programs	16
• Other Data Quality Considerations	16
D. How Water Quality Data is Evaluated to Determine Whether or Not Waters are Impaired for 303(d) Listing Purposes	18
• Physical, Chemical, Biological and Toxicity Data	18
• Weight of Evidence Approach.....	18
• Biological Data	19
• Other Biological Data	32
• Toxic Chemicals	33
• Duration of Assessment Period.....	34
• Assessment of Tier Three Waters	34
• Other Types of Information	35
E. Other 303(d) Listing Considerations	36
F. Prioritization of Waters for TMDL Development	36
G. Resolution of Interstate/International Disagreements.....	37
H. Statistical Considerations	37
• Description of Analytical Tools.....	37
• Rationale for the Burden-of-Proof.....	37
• Level of Significance Used in Tests	39
• Use of the Binomial Probability Distribution for Interpretation of the 10 Percent Rule	39
• Other Statistical Considerations.....	40
• Examples of Statistical Procedures	40
I. References.....	42
Appendix A	44
Appendix B	47
Appendix C	51
Appendix D	56

I. Citation and Requirements

A. Citation of Section of Clean Water Act

The Missouri Department of Natural Resources (MDNR) is responsible for the implementation and administration of the Federal Clean Water Act in Missouri. Pursuant to Section 40 CFR 130.7, States, Territories or authorized Tribes must submit biennially to the United States Environmental Protection Agency (EPA) a list of water quality limited (impaired) segments, pollutants causing impairment, and the priority ranking of waters targeted for Total Maximum Daily Load (TMDL) development. Federal regulation at 40 CFR 130.7 also requires States, Territories, and authorized Tribes to submit to EPA a written methodology document describing the State's approach in considering, and evaluating existing readily available data used to develop their 303(d) list of impaired water bodies. The listing methodology must be submitted to the EPA each year the Section 303(d) list is due. While EPA does not approve or disapprove the listing methodology, the agency considers the methodology during its review of the states 303(d) impaired waters list and the determination to list or not to list waters.

Following the Missouri Clean Water Commission approval, Section 303(d) is submitted to EPA. This fulfills Missouri's biennial submission requirements of an integrated report required under Sections 303(d), 305(b) and 314 of the Clean Water Act. In years when no integrated report is submitted, the department submits a copy of its statewide water quality assessment database to EPA.

B. U.S. EPA Guidance

In 2001 the Office of General Counsel and the Office of Wetlands, Oceans, and Watersheds developed a recommended framework to assist EPA regions in the preparation of their approval letters for the States' 2002 Section 303(d) list submissions. This was to provide consistency in making approval decisions along with guidance for integrating the development and submission of the 2002 Section 305(b) water quality reports and Section 303(d) list of impaired waters¹.

The following sections provide an overview of EPA Integrated Report guidance documents from calendar year 2002 through 2015.

The 2002 Integrated Water Quality Monitoring and Assessment Report Guidance was the first document EPA provided to the States, Territories, and authorized Tribes with directions on how to integrate the development and submission of the 2002 305(b) water quality reports and Section 303(d) list of impaired waters.

The guidance recommended that States, Territories and authorized Tribes submit a combined integrated report that would satisfy the Clean Water Act requirements for both Section 305(b) water quality reports and Section 303(d) list. The 2002 Integrated Report was to include:

¹ Additional information can be obtained from EPA's website:
<http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/guidance.cfm>.

- Delineation of water quality assessment units based on the National Hydrography Dataset (NHD);
- Status of and progress toward achieving comprehensive assessments of all waters;
- Water quality standard attainment status for every assessment unit;
- Basis for the water quality standard attainment determinations for every assessment unit;
- Additional monitoring that may be needed to determine water quality standard attainment status and, if necessary, to support development of total maximum daily loads (TMDLs) for each pollutant/assessment unit combination;
- Schedules for additional monitoring planned for assessment units;
- Pollutant/assessment unit combinations still requiring TMDLs; and
- TMDL development schedules reflecting the priority ranking of each pollutant/assessment unit combination.

The 2002 EPA guidance described the requirements under Section 303(d) of the Clean Water Act where states were required to describe the methodology used to develop their 303(d) list. EPA's guidance recommended the states provide: (1) a description of the methodology used to develop Section 303(d) list; (2) a description of the data and information used to identify impaired and threatened waters; (3) a rationale for not using any readily available data and information; and (4) information on how interstate or international disagreements concerning the list are resolved. Lastly (5), it is recommended that "prior to submission of its Integrated Report, each state should provide the public the opportunity to review and comment on the methodology." In accordance with EPA guidance, the department reviews and updates the Listing Methodology Document (LMD) every two years. The LMD is made available to the public for review and comment at the same time the state's 303(d) impaired waters list is published for public comment. Following the public comment period, the department responds to public comments and provides EPA with a document summarizing all comments received.

In July 2003, EPA issued new guidance entitled "Guidance for 2004 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act." This guidance gave further recommendations about listing of 303(d) and other waters.

In July 2005, EPA published an amended version entitled "Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act" (see Appendix A for Excerpt).

In October 2006, EPA issued a memorandum entitled "Information Concerning 2008 Clean Water Act Sections 303(d), 305(b) and 314 Integrated Reporting and Listing Decisions." This memorandum serves as EPA's guidance for the 2008 reporting cycle and beyond. This guidance recommended the use of a five-part categorization scheme and that each state provides a comprehensive description of the water quality standards attainment status of all segments within a state (reference Table 1 below). The guidance also defined a "segment" as being used synonymous with the term "assessment unit" used in previous Integrated Report Guidance. Overall, the selected segmentation approach should be consistent with the state's water quality standards and be capable of providing a spatial scale that is adequate to characterize the water quality standards attainment status for the segment.

It was in the 2006 guidance that EPA recommended all waters of the state be placed in one of five categories described below.

Table 1. Placement of Waters within the Five Categories in the 2006² EPA Assessment, Listing and Reporting Guidance

<p><u>Category 1</u></p>	<p>All designated uses are fully maintained. Data or other information supporting full use attainment for all designated uses must be consistent with the state's Listing Methodology Document (LMD). The department will place a water in Category 1 if the following conditions are met:</p> <ul style="list-style-type: none"> • The water has physical and chemical data (at a minimum, water temperature, pH, dissolved oxygen, ammonia, total cobalt, and total copper for streams, and total nitrogen, total phosphorus and secchi depth for lakes) and biological water quality data (at a minimum, <i>E. coli</i> or fecal coliform bacteria) that indicates attainment with water quality standards. • The level of mercury in fish fillets or plugs used for human consumption is 0.3 mg/kg or less. Only samples of higher trophic level species (largemouth, smallmouth and spotted bass, sauger, walleye, northern pike, trout (rainbow and trout), striped bass, white bass, flathead catfish and blue catfish) will be used. • The water is not rated as "threatened."
<p><u>Category 2</u></p>	<p>One or more designated uses are fully attained but at least one designated use has inadequate data or information to make a use attainment decision consistent with the state's LMD. The department will place a water in Category 2 if at least one of the following conditions are met:</p> <ul style="list-style-type: none"> • There is inadequate data for water temperature, pH, dissolved oxygen, ammonia, total cobalt or total copper in streams to assess attainment with water quality standards or inadequate data for total nitrogen, total phosphorus or secchi depth in lakes. • There is inadequate <i>E. coli</i> or fecal coliform bacteria data to assess attainment of the whole body contact recreational use. • There are insufficient fish fillet tissue, or plug data available for mercury to assess attainment of the fish consumption use. <p>Category 2 waters will be placed in one of two sub-categories.</p> <p>Category 2A: Waters will be placed in this category if available data, using best professional judgement, suggests compliance with numerical water quality criteria of Tables A or B in Missouri's Water Quality Standards (10 CSR 20-7.031) or other quantitative thresholds for determining use attainment.</p>

² <http://www.epa.gov/sites/production/files/2015-10/documents/2006irg-report.pdf>

	<p>Category 2B: Waters will be placed in this category if the available data, using best professional judgment, suggests noncompliance with numeric water quality criteria of Tables A or B in Missouri's Water Quality Standards, or other quantitative thresholds for determining use attainment, and these data are insufficient to support a statistical test or to qualify as representative data. Category 2B waters will be given high priority for additional water quality monitoring.</p>
<u>Category 3</u>	<p>Water quality data are not adequate to assess any of the designated beneficial uses consistent with the LMD. The department will place a water in Category 3 if data are insufficient to support a statistical test or to qualify as representative data to assess any of the designated uses. Category 3 waters will be placed in one of two sub-categories.</p> <p>Category 3A. Waters will be placed in this category if available data, using best professional judgment, suggests compliance with numerical water quality criteria of Tables A or B in Missouri's Water Quality Standards (10 CSR 20-7.031) or other quantitative thresholds for determining use attainment. Category 3A waters will be tagged for additional water quality monitoring, but will be given lower priority than Category 3B waters.</p> <p>Category 3B. Waters will be placed in this category if the available data, using best professional judgment, suggest noncompliance with numerical water quality criteria of Tables A or B in Missouri's Water Quality Standards or other quantitative thresholds for determining use attainment. Category 3B waters will be given high priority for additional water quality monitoring.</p>
<u>Category 4</u>	<p>State water quality standards or other criteria, as per the requirements of Appendix B & C of this document, are not attained, but a Total Maximum Daily Load (TMDL) study is not required. Category 4 waters will be placed in one of three sub-categories.</p> <p>Category 4A. EPA has approved a TMDL study that addresses the impairment. The department will place a water in Category 4A if both the following conditions are met:</p> <ul style="list-style-type: none"> Any portion of the water is rated as being in non-attainment with state water quality standards or other criteria as explained in

	<p>Appendix B & C of this document due to one or more discrete pollutants or discrete properties of the water³, and</p> <ul style="list-style-type: none"> EPA has approved a TMDL for all pollutants that are causing non-attainment. <p>Category 4B. Water pollution controls required by a local, state or federal authority, are expected to correct the impairment in a reasonable period of time. The department will place a water in Category 4B if both of the following conditions are met:</p> <ul style="list-style-type: none"> Any portion of the water is rated as being in non-attainment with state water quality standards or other criteria as explained in Appendix B & C of this document due to one or more discrete pollutants or discrete properties of water², and A water quality based permit that addresses the pollutant(s) causing the designated use, impairment has been issued, and compliance with the permit limits will eliminate the impairment; or other pollution control requirements have been made that are expected to adequately address the pollutant(s) causing the impairment. This may include implemented voluntary watershed control plans as noted in EPA's guidance document. <p>Category 4C. Any portion of the water is rated as being in non-attainment with state water quality standards or other criteria as explained in Appendix B & C of this document, and a discrete pollutant(s) or other discrete property of the water² does not cause the impairment. Discrete pollutants may include specific chemical elements (e.g., lead, zinc), chemical compounds (e.g., ammonia, dieldrin, atrazine) or one of the following quantifiable physical, biological or bacteriological conditions: water temperature, percent of gas saturation, amount of dissolved oxygen, pH, deposited sediment, toxicity or counts of fecal coliform or <i>E. coli</i> bacteria.</p>
<u>Category 5</u>	<p>At least one discrete pollutant has caused non-attainment with state water quality standards or other criteria as explained in Appendix B & C of this document, and the water does not meet the qualifications for listing as either Categories 4A or 4B. Category 5 waters are those that are candidates for the state's 303(d) List⁴.</p> <p>If a designated use is not supported and the segment is impaired or threatened, the fact that a specific pollutant is not known does not provide a basis for excluding a segment from Category 5.</p>

³ A discrete pollutant or a discrete property of water is defined here as a specific chemical or other attribute of the water (such as temperature, dissolved oxygen or pH) that causes beneficial use impairment and that can be measured quantitatively.

⁴ The proposed state 303(d) List is determined by the Missouri Clean Water Commission and the final list is determined by the U.S. Environmental Protection Agency.

	<p>Category 5. These segments must be listed as Category 5 unless the state can demonstrate that no discrete pollutant(s) causes or contributes to the impairment. Pollutants causing the impairment will be identified through the 303(d) assessment and listing process before a TMDL study is written. The TMDL should be written within the time frame preferred in EPA guidance for TMDL development, when it fits within the state's TMDL prioritization scheme.</p> <p>Category 5-alt. A water body assigned to 5-alt is an impaired water without a completed TMDL but assigned a low priority for TMDL development because an alternative restoration approach is being pursued. This also provides transparency to the public that a state is pursuing restoration activities in those waters to achieve water quality standards. The addition of this sub-category will facilitate tracking alternative restoration approaches in 303(d) listed waters in priority areas.</p>
<u>Threatened Waters</u>	<p>When a water is currently attaining all designated uses, but the data shows an inverse (time) trend in quality for one or more discrete water quality pollutants indicating the water will not continue to meet these uses before the next listing cycle. Such water will be considered "threatened." A threatened water will be treated as an impaired water and placed in the appropriate Category (4A, 4B, or 5).</p>

In subsequent years, EPA has provided additional guidance, but only limited new supplemental information has been provided since the 2008 cycle.

In August 2015, the EPA provided draft guidance that would include a Category 5-alternative (5-alt) (reference Table 1 above). Additional information can be found at EPA's website: <http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/guidance.cfm>.

II. The Methodology Document

A. Procedures and Methods Used to Collect Water Quality Data

- Department Monitoring

The major purposes of the department's water quality monitoring program are to:

- characterize background or reference water quality conditions;
- better understand daily, flow event and seasonal water quality variations and their underlying processes;
- characterize aquatic biological communities;
- assess trends in water quality;
- characterize local and regional effects of point and nonpoint sources pollutants on water quality;
- check for compliance with water quality standards and/or wastewater permit limits;
- support development of strategies, including Total Maximum Daily Loads, to return impaired waters to compliance with Water Quality Standards. All of these objectives are statewide in scope.

- Coordination with Other Monitoring Efforts in Missouri

To maximize efficiency, the department routinely coordinates its monitoring activities with other agencies to avoid overlap, and to give and receive feedback on monitoring design. Data from other sources are used for meeting the same objectives as department-sponsored monitoring. The data must fit the criteria described in the data quality considerations section of this document. The agencies most often involved are the U.S. Geological Survey, the U.S. Army Corps of Engineers, EPA, the Missouri Department of Conservation (MDC), and the Missouri Department of Health and Senior Services. The Department of Natural Resources also tracks the monitoring efforts of the National Park Service; the U.S. Forest Service; several of the state's larger cities; the states of Oklahoma, Arkansas, Kansas, Iowa, and Illinois; and graduate level research conducted at universities within Missouri. For those wastewater discharges where the department has required instream water quality monitoring, the department may also use monitoring data acquired by wastewater dischargers as a condition of discharge permits issued by the department. In 1995, the department also began using data collected by volunteers that have passed Volunteer Water Quality Monitoring Program Quality Assurance/Quality Control tests.

- Existing Monitoring Networks and Programs

The following is a list and a brief description of the kinds of water quality monitoring activities presently occurring in Missouri.

1. Fixed Station Network

- a) Objective: To better characterize background or reference water quality conditions, to better understand daily, flow events, and seasonal water quality variations and their underlying processes, to assess trends and to check for compliance with water quality standards.
- b) Design Methodology: Sites are chosen based on one of the following criteria:
 - Site is believed to have water quality representative of many neighboring streams of similar size due to similarity in watershed geology, hydrology and land use, and the absence of any impact from a significant point or discrete nonpoint water pollution source.
 - Site is downstream of a significant point source or discrete nonpoint source area.
- c) Number of Sites, Sampling Methods, Sampling Frequency, and Parameters:
 - MDNR/U.S. Geological Survey cooperative network: approximately 70 sites statewide, horizontally and vertically integrated grab samples, four to twelve times per year. Samples are analyzed for major ions (e.g. calcium, magnesium, sulfate, and chloride), nutrients (e.g. phosphorus and nitrogen), temperature, pH, dissolved oxygen, specific conductance, bacteria (e.g. *Escherichia coli* (*E. coli*) and fecal coliform) and flow on all visits, two to four times annually for suspended solids and heavy metals, and for pesticides six times annually at four sites.
 - MDNR/University of Missouri-Columbia's lake monitoring network. This program has monitored about 249 lakes since 1989. About 75 lakes are monitored each year. Each lake is usually sampled four times during the summer and about 12 are monitored spring through fall for nutrients, chlorophyll, turbidity and suspended solids.
 - Department routine monitoring of finished public drinking water supplies for bacteria and trace contaminants.
 - Routine bacterial monitoring for *E. coli* of swimming beaches at Missouri's state parks during the recreational season by the department's Missouri State Parks.
 - Monitoring of sediment quality by the department at approximately 10-12 discretionary sites annually. Sites are monitored for several heavy metals (e.g. arsenic, cadmium, copper, lead, mercury, nickel, zinc, etc.) and/or organic contaminants (e.g. polycyclic aromatic hydrocarbons, etc.).

2. Special Water Quality Studies

- a) Objective: Special water quality studies are used to characterize water quality effects from a specific pollutant source area.

- b) **Design Methodology:** These studies are designed to verify and measure the contaminants of concern based on previous water quality studies, effluent sampling and/or Missouri State Operating Permit applications. These studies employ multiple sampling stations downstream and upstream (if appropriate). If contaminants of concern have significant seasonal or daily variation, the sampling design must account for such variation.
- c) **Number of Sites, Sampling Methods, Sampling Frequency and Parameters:** The department conducts or contracts up to 10 to 15 special studies annually, as funding allows. Each study has multiple sampling sites. The number of sites, sampling frequency and parameters all vary greatly depending on the study. Intensive studies would also require multiple samples per site over a relatively short time frame.

3. Toxics Monitoring Program

The fixed station network and many of the department's intensive studies monitor for acute and chronic toxic chemicals⁵. In addition, major municipal and industrial dischargers must monitor for acute and chronic toxicity in their effluents as a condition of their Missouri State Operating Permit.

4. Biological Monitoring Program

- a) **Objectives:** The objectives of the Biological Monitoring programs are to develop numeric criteria describing "reference" aquatic macroinvertebrate and fish communities in Missouri's streams, to implement these criteria within state water quality standards and to maintain a statewide fish and aquatic macroinvertebrate monitoring program.
- b) **Design Methodology:** Development of biocriteria for fish and aquatic macroinvertebrates⁶ involves identification of reference streams in each of Missouri's aquatic ecoregions and 17 ecological drainage units, respectively. It also includes intensive sampling of invertebrate and fish communities to quantify temporal and spatial variation in reference streams within ecoregions and variation among ecoregions, and the sampling of chemically and physically impaired streams to test sensitivity of various community metrics to differences in stream quality.
- c) **Number of Sites, Sampling Methods, Sampling Frequency and Parameters:** The department has conducted biological sampling of aquatic macroinvertebrates for many years. Since 1991, the department's aquatic macroinvertebrate monitoring program has consisted of standardized monitoring of approximately 45 to 55 sites twice annually. In addition, the MDC presently has a statewide fish and aquatic macroinvertebrate monitoring program, the Resource Assessment and Monitoring (RAM) Program, designed monitor and assess the health of Missouri's stream resources on a rotating basis. This program samples a minimum of 450 random and 30 reference sites every five years.

⁵ As defined in 10 CSR 20-7.031(1)

⁶ For additional information visit: <http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>

5. Fish Tissue Monitoring Program

- a) Objective: Fish tissue monitoring addresses two objectives: (1) the assessment of ecological health or the health of aquatic biota (usually accomplished by monitoring whole fish samples); and (2) the assessment of human health risk based on the level of contamination of fish tissue plugs, or fillets.
- b) Design Methodology: Fish tissue monitoring sites are chosen based on one of the following criteria:
 - Site is believed to have water and sediment quality representative of many neighboring streams or lakes of similar size due to similarity in geology, hydrology and land use, and the absence of any known impact from a significant point source or discrete nonpoint water pollution source.
 - Site is downstream of a significant point source or discrete nonpoint source area.
 - Site has shown fish tissue contamination in the past.

- c) Number of Sites, Sampling Methods, Sampling Frequency and Parameters:

The department plans to maintain a fish tissue monitoring program to collect whole fish composite samples⁷ at approximately 13 fixed sites. In previous years, this was a cooperative effort between EPA and the department through EPA's Regional Ambient Fish Tissue (RAFT) Monitoring Program. Each site will be sampled once every two years. The preferred species for these sites are either Common Carp (*Cyprinus carpio*) or one of the Redhorse (a.k.a. sucker) species (*Moxostoma* sp.).

The department, EPA, and MDC also sample 40 to 50 discretionary sites annually for two fish fillet composite samples or fish tissue plug samples (mercury only) from fish of similar size and species. One sample is of a top carnivore such as Largemouth Bass (*Micropterus salmoides*), Smallmouth Bass (*Micropterus dolomieu*), Walleye (*Sander vitreum*), or Sauger (*Zander luciperca*). The other sample is for a species of a lower trophic level such as catfish, Common Carp or sucker species (Catostomidae). This program occasionally samples fish eggs for certain fish species at selected locations. Both of these monitoring programs analyze for several chlorinated hydrocarbon insecticides, PCBs, lead, cadmium, mercury, and fat content.

6. Volunteer Monitoring Program

Two major volunteer monitoring programs generate water quality data in Missouri. The data generated from these programs are used for statewide 305(b) reporting on general water quality health, used as a screening level tool to determine where additional monitoring is needed, or used to supplement other water quality data for watershed planning purposes.

- Lakes of Missouri Volunteer Program⁸. This cooperative program consists of persons from the department, the University of Missouri-Columbia, and volunteers who monitor

⁷ A composite sample is one in which several individual fish are combined to produce one sample.

⁸ For additional program information visit: <http://www.lmvp.org/>

approximately 137 sites on 66 lakes, including Lake Taneycomo, Table Rock Lake and several lakes in the Kansas City area. Lake volunteers are trained to collect samples for total phosphorus, total nitrogen, chlorophyll and inorganic suspended sediments. Data from this program is used by the university as part of a long-term study on the limnology of mid-western reservoirs.

- **Volunteer Water Quality Monitoring Program.** The Volunteer Water Quality Monitoring Program⁹ is an activity of the Missouri Stream Team Program, which is a cooperative project sponsored by the department, the Missouri Department of Conservation, and the Conservation Federation of Missouri. The program involves volunteers who monitor water quality of streams throughout Missouri. There are currently over 5,000 Stream Teams and more than 3,600 trained water quality monitors. Approximately 80,000 citizens are served each year through the program. Since the beginning of the Stream Team program, 494,232 volunteers have donated about 2 million hours valued at more than \$38 million to the State of Missouri.

After the Introductory class, many attend at least one more class of higher level training: Levels 1, 2, 3 and 4. Each level of training is a prerequisite for the next higher level, as is appropriate data submission. Data generated by Levels 2, 3, and 4 and the new Cooperative Site Investigation (CSI) Program volunteers represent increasingly higher quality assurance. For CSI projects, the volunteers have completed a quality assurance/quality control workshop, completed field evaluation, and/or have been trained to collect samples following department protocols. Upon completing Introductory and Level 1 and 2 training, volunteers will have received the basic level training to conduct visual stream surveys, stream discharge measurements, biological monitoring, and collect physical and chemical measurements for pH, conductivity, dissolved oxygen, nitrate, phosphate, and turbidity.

Of those completing an Introductory course, about 35 percent proceed to Levels 1 and 2. To date, 104 volunteers have reached Level 3 and six volunteers have reached Level 4. The CSI Program uses trained volunteers to collect samples and transport them to laboratories approved by the department. Volunteers and department staff work together to develop a monitoring plan. Currently there are 39 volunteers qualified to work in the CSI Program. All Level 2, 3, and 4 volunteers, as well as all CSI trained volunteers, are required to attend a validation session every 3 years to ensure equipment, reagents and methods meet program standards. To date 106 individuals have attended a validation session at least once.

- Identification of All Existing and Readily Available Water Quality Data Sources

Data Solicitation Request

⁹ For additional program information visit: <http://dnr.mo.gov/env/wpp/VWQM.htm>

In calendar year 2014, the department sent out a request for all available water quality data (chemical and biological). The data solicitation requested water quality data for approximately a two year timeframe prior to the current listing year. The data solicitation request was sent to multiple agencies, neighboring states, and organizations. In addition, and as part of the data solicitation process, the department queries available water quality data from national databases such as EPA's Storage and Retrieval (STORET)/Water Quality Exchange (WQX) data warehouse¹⁰, and the USGS Water Quality Portal¹¹.

The data must be spatially and temporally representative of the actual annual ambient conditions of the water body. Sample locations should be characteristic and representative of the main water mass or distinct hydrologic areas. With the exception of the data collected for those designated uses that require seasonally based data (e.g., whole body contact recreation, biological community data, and critical season dissolved oxygen), data should be distributed over at least three seasons, over two years, and should not be biased toward specific conditions (such as runoff, season, or hydrologic conditions).

Data meeting the following criteria will be accepted.

- Samples must be collected and analyzed under a Quality Assurance/Quality Control (QA/QC) protocol that follows the EPA requirements for quality assurance project plans.
- Samples must be analyzed following protocols that are consistent with the EPA or Standard Method procedures.
- All data submitted must be accompanied by a copy of the organization's QA/QC protocol and standard operating procedures.
- All data must be reported in standard units as recommended in the relevant approved methods.
- All data must be accompanied by precise sample location(s), preferably in either decimal degrees or Universal Transverse Mercator (UTM).
- All data must be received in a Microsoft Excel or compatible format.
- All data must have been collected within the requested period of record.

All readily available and acceptable data are uploaded into the department's Water Quality Assessment Database¹², where the data undergoes quality control checks prior to 303(d) or 305(b) assessment processes.

- Laboratory Analytical Support

Laboratories used:

- Department/U.S. Geological Survey Cooperative Fixed Station Network: U.S. Geological Survey Lab, Denver, Colorado

¹⁰ http://www.epa.gov/storet/dw_home.html

¹¹ <http://www.waterqualitydata.us/>

¹² http://dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

- Intensive Surveys: Varies, many are done by the department's Environmental Services Program
- Toxicity Testing of Effluents: Many commercial laboratories
- Biological Criteria for Aquatic Macroinvertebrates: department's Environmental Services Program and University of Missouri-Columbia
- Fish Tissue: EPA Region VII Laboratory, Kansas City, Kansas, and miscellaneous contract laboratories (Missouri Department of Conservation or U.S. Geological Survey's Columbia Environmental Research Center)
- Missouri State Operating Permit: Self-monitoring or commercial laboratories
- Department's Public Drinking Water Monitoring: department's Environmental Services Program and commercial laboratories¹³
- Other water quality studies: Many commercial laboratories

B. Sources of Water Quality Data

The following data sources are used by the department to aid in the compilation of the state's integrated report (previously the 305(b) report). Where quality assurance programs are deemed acceptable, additional sources would also be used to develop the state's Section 303(d) list. These sources presently include, but are not limited to:

1. Fixed station water quality and sediment data collected and analyzed by the department's Environmental Services Program personnel.
2. Fixed station water quality data collected by the U.S. Geological Survey under contractual agreements with the department.
3. Fixed station water quality data collected by the U.S. Geological Survey under contractual agreements to agencies or organizations other than the department.
4. Fixed station water quality, sediment quality, and aquatic biological information collected by the U.S. Geological Survey under their National Stream Quality Accounting Network and the National Water Quality Assessment Monitoring Programs.
5. Fixed station raw water quality data collected by the Kansas City Water Services Department, the St. Louis City Water Company, the Missouri American Water Company (formerly St. Louis County Water Company), Springfield City Utilities, and Springfield's Department of Public Works.
6. Fixed station water quality data collected by the U.S. Army Corps of Engineers. The Kansas City, St. Louis, and Little Rock Corps Districts have monitoring programs for Corps-operated reservoirs in Missouri.
7. Fixed station water quality data collected by the Arkansas Department of Environmental Quality, the Kansas Department of Health and Environment, the Iowa Department of Natural Resources, and the Illinois Environmental Protection Agency.
8. Fixed station water quality monitoring by corporations.

¹³ For additional information visit: <http://dnr.mo.gov/env/wpp/labs/>

9. Annual fish tissue monitoring programs by EPA/Department RAFT Monitoring Program and MDC.
10. Special water quality surveys conducted by the department. Most of these surveys are focused on the water quality impacts of specific point source wastewater discharges. Some surveys are of well-delimited nonpoint sources such as abandoned mined lands. These surveys often include physical habitat evaluation and monitoring of aquatic macroinvertebrates as well as water chemistry monitoring.
11. Special water quality surveys conducted by U.S. Geological Survey, including but not limited to:
 - a) Geology, hydrology and water quality of various hazardous waste sites,
 - b) Geology, hydrology and water quality of various abandoned mining areas,
 - c) Hydrology and water quality of urban nonpoint source runoff in metropolitan areas of Missouri (e.g. St. Louis, Kansas City, and Springfield), and
 - d) Bacterial and nutrient contamination of streams in southern Missouri.
12. Special water quality studies by other agencies such as MDC, the U.S. Public Health Service, and the Missouri Department of Health and Senior Services.
13. Monitoring of fish occurrence and distribution by MDC.
14. Fish Kill and Water Pollution Investigations Reports published by MDC.
15. Selected graduate research projects pertaining to water quality and/or aquatic biology.
16. Water quality, sediment, and aquatic biological data collected by the department, EPA or their contractors at hazardous waste sites in Missouri.
17. Self-monitoring of receiving streams by cities, sewer districts and industries, or contractors on their behalf, for those discharges that require this kind of monitoring. This monitoring includes chemical and sometimes toxicity monitoring of some of the larger wastewater discharges, particularly those that discharge to smaller streams and have the greatest potential to affect instream water quality.
18. Compliance monitoring of receiving waters by the department and EPA. This can include chemical and toxicity monitoring.
19. Bacterial monitoring of streams and lakes by county health departments, community lake associations, and other organizations using acceptable analytical methods.
20. Other monitoring activities done under a quality assurance project plan approved by the department.
21. Fixed station water quality and aquatic macroinvertebrate monitoring by volunteers who have successfully completed the Volunteer Water Quality Monitoring Program Level 2 workshop. Data collected by volunteers who have successfully completed a training Level 2 workshop is considered to be Data Code One. Data generated from Volunteer Training Levels 2, 3 and 4 are considered "screening" level data and can be useful in providing an indication of a water quality problem. For this reason, the data are eligible

for use in distinguishing between waters in Categories 2A and 2B or Categories 3A and 3B. Most of this data are not used to place waters in main Categories (1, 2, 3, 4, and 5) because analytical procedures do not use EPA or Standard Methods or other department approved methods. Data from volunteers who have not yet completed a Level 2 training workshop do not have sufficient quality assurance to be used for assessment. Data generated by volunteers while participating in the department's Cooperative Site Investigation Program (Section II C1) or other volunteer data that otherwise meets the quality assurance outlined in Section II C2 may be used in Section 303(d) assessment.

The following data sources (22-23) **cannot** be used to rate a water as impaired (Categories 4A, 4B, 4C or 5); however, these data sources may be used to direct additional monitoring that would allow a water quality assessment for Section 303(d) listing.

22. Fish Management Basin Plans published by MDC.
23. Fish Consumption Advisories published annually by the Missouri Department of Health and Senior Services. Note: the department may use data from data source listed as Number 9 above, to list individual waters as impaired due to contaminated fish tissue.

As previously stated, the department will review all data of acceptable quality that are submitted to the department prior to the first public notice of the draft 303(d) list. However, the department will reserve the right to review and use data of acceptable quality submitted after this date if the data results in a change to the assessment outcome of the water.

C. Data Quality Considerations

- DNR Quality Assurance/Quality Control Program

The department and EPA Region VII have completed a Quality Management Plan. All environmental data generated directly by the department, or through contracts funded by the department, or EPA require a Quality Assurance Project Plan¹⁴. The agency or organization responsible for collecting and/or analyzing environmental data must write and adhere to a Quality Assurance Project Plan approved through the department's Quality Management Plan. Any environmental data generated via a monitoring plan with a department approved Quality Assurance Project Plan are considered suitable for use in water quality assessment and the 303(d) listing. This includes data generated by volunteers participating in the department's CSI Program. Under this program, the department's Environmental Services Program will audit selected non-profit (governmental and university) laboratories. Laboratories that pass this audit will be approved for the CSI Program. Individual volunteers who collect field samples and deliver them to an approved laboratory must first successfully complete department training on how to properly collect and handle environmental samples. The types of information that will allow the department to make a judgment on the acceptability of a

¹⁴ For additional information visit: <http://www.epa.gov/quality/qapps.html>

quality assurance program are: (1) a description of the training, and work experience of the persons involved in the program, (2) a description of the field meters and maintenance and calibration procedures, (3) a description of sample collection and handling procedures, and (4) a description of all analytical methods used in the laboratory for analysis.

- Other Quality Assurance/Quality Control Programs

Data generated in the absence of a department-approved Quality Assurance Project Plan may be used to assess a water body if the department determines that the data are adequate after reviewing and accepting the quality assurance procedures plan used by the data generator. This review would include: (1) names of all persons involved in the monitoring program, their duties, and a description of their training and work related experience, (2) all written procedures, Standard Operating Procedures, or Quality Assurance Project Plans pertaining to this monitoring effort, (3) a description of all field methods used, brand names and model numbers of any equipment, and a description of calibration and maintenance procedures, and (4) a description of laboratory analytical methods. This review may also include an audit by the department's Environmental Services Program.

- Other Data Quality Considerations

Data Age. For assessing present conditions, more recent data are preferable; however, older data may be used to assess present conditions if the data remains representative of present conditions.

If the department uses data older than seven years to make a Section 303(d) list decision a written justification for the use of such data will be provided.

A second consideration is the age of the data relative to significant events that may have an effect on water quality. Data collected prior to the initiation, closure, or significant change in a wastewater discharge, or prior to a large spill event or the reclamation of a mining or hazardous waste site, for example, may not be representative of present conditions. Such data would not be used to assess present conditions even if it was less than seven years old. Such "pre-event" data can be used to determine changes in water quality before and after the event or to show water quality trends.

Data Type, Amount and Information Content. EPA recommends establishing a series of data codes, and rating data quality by the kind and amount of data present at a particular location ([EPA 1997¹⁵](#)). The codes are single-digit numbers from one to four, indicating the relative degree of assurance the user has in the value of a particular environmental data set. Data Code One indicates the least assurance or the least number of samples or

¹⁵ *Guidelines for the Preparation of the Comprehensive State Water Quality Assessments (305b) and Electronic Updates*, 1997. (<http://water.epa.gov/type/watersheds/monitoring/repguid.cfm>)

analytes and Data Code Four the greatest. Based on EPA's guidance, the department uses the following rules to assign code numbers to data.

- Data Code¹⁶ One: All data not meeting the requirements of the other data codes.
- Data Code Two: Chemical data collected quarterly to bimonthly for at least three years, or intensive studies that monitor several nearby sites repeatedly over short periods of time, or at least three composite or plug fish tissue samples per water body, or at least five bacterial samples collected during the recreational season of one calendar year.
- Data Code Three: Chemical data collected at least monthly for more than three years on a variety of water quality constituents including heavy metals and pesticides; or a minimum of one quantitative biological monitoring study of at least one aquatic assemblage (fish, macroinvertebrates, or algae) at multiple sites, multiple seasons (spring and fall), or multiple samples at a single site when data from that site is supported by biological monitoring at an appropriate control site.
- Data Code Four: Chemical data collected at least monthly for more than three years that provides data on a variety of water quality constituents including heavy metals and pesticides, and including chemical sampling of sediments and fish tissue; or a minimum of one quantitative biological monitoring study of at least two aquatic assemblages (fish, macroinvertebrates, or algae) at multiple sites.

In Missouri, the primary purpose of Data Code One data is to provide a rapid and inexpensive method of screening large numbers of waters for obvious water quality problems and to determine where more intensive monitoring is needed. In the preparation of the state's Integrated Report, data from all four data quality levels are used. Most of the data is of Data Code One quality, and without Data Code One data, the department would not be able to assess a majority of the state's waters.

In general, when selecting water bodies for the Missouri 303(d) List, only Data Code Two or higher are used, unless the problem can be accurately characterized by Data Code One data.¹⁷ The reason is that Data Code Two data provides a higher level of assurance that a Water Quality Standard is not actually being attained and that a TMDL study is necessary. All water bodies placed in Categories 2 or 3 receive high priority for additional monitoring so that data quality is upgraded to at least Data Code Two. Category 2B and 3B waters will be given higher priority than Categories 2A and 3A.

¹⁶ Data Code One is equivalent to data water quality assurance Level One in 10 CSR 20-7.050 General Methodology for Development of Impaired Waters List, subsection (2)(C), Data Code Two is equivalent to Level 2, etc.

¹⁷ When a listing, amendment or delisting of a 303(d) water is made with only Data Code One data, a document will be prepared that includes a display of all data and a presentation of all statistical tests or other evaluative techniques that documents the scientific defensibility of the data. This requirement applies to all Data Code One data identified in Appendix B of this document.

D. How Water Quality Data is Evaluated to Determine Whether or Not Waters are Impaired for 303(d) Listing Purposes

- Physical, Chemical, Biological and Toxicity Data

During each reporting cycle, the department and stakeholders review and revise the guidelines for determining water quality impairment. The guidelines shown in Appendix B & C provides the general rules of data use and assessment and Appendix D provides details about the specific analytical procedure used. In addition, if trend analysis indicates that presently unimpaired waters will become impaired prior to the next listing cycle, these “threatened waters” will be judged as impaired. Where antidegradation provisions in Missouri’s Water Quality Standards apply, those provisions shall be upheld. The numerical criteria included in Appendix B have been adopted into the state water quality standards, 10 CSR 20-7.031, and are used, as described in Appendix B to make use attainment decisions.

- Weight of Evidence Approach

When evaluating narrative criteria described in the state water quality standards, 10 CSR 20-7.031, the department will use a weight of evidence analysis for assessing numerical translators that have not been adopted into state water quality standards (see Appendix C). Under the weight of evidence approach, all available information is examined and the greatest weight is given to data providing the “best supporting evidence” for an attainment decision. Determination of “best supporting evidence” will be made using best professional judgment, considering factors such as data quality, and site-specific environmental conditions. For those analytes with numeric thresholds, the threshold values given in Appendix C will trigger a weight of evidence analysis to determine the existence or likelihood of a use impairment and the appropriateness of proposing a 303(d) listing based on narrative criteria. This weight of evidence analysis will include the use of other types of environmental data when it is available or collection of additional data to make the most informed use attainment decision. Examples of other relevant environmental data might include physical or chemical data, biological data on fish [Fish Index of Biotic Integrity (fIBI)] or aquatic macroinvertebrate [Macroinvertebrate Stream Condition Index (MSCI)] scores, fish tissue, or toxicity testing of water or sediments.

Biological data will be given greater weight in a weight of evidence analysis for making attainment decisions for aquatic life use and subsequent Section 303(d) listings. Whether or not numeric translators of biological criteria are met is a strong indicator for the attainment of aquatic life use. Moreover, the department retains a high degree of confidence in an attainment decision based on biological data that is representative of water quality condition.

When the weight of evidence analysis suggests, but does not provide strong scientifically valid evidence of impairment, the department will place the water body in question in Categories 2B or 3B. The department will produce a document showing all relevant data

and the rationale for the attainment decision. All such documents will be available to the public at the time of the first public notice of the proposed 303(d) list. A final recommendation on the listing of a water body based on narrative criteria will only be made after full consideration of all comments on the proposed list.

- Biological Data

Methods for assessing biological data typically receive considerable attention during the public comment period of development of the Listing Methodology Document. Currently, a defined set of biocriteria are used to evaluate biological data for assessing compliance with water quality standards. These biological criteria contain numeric thresholds, that when exceeded relative to prescribed assessment methods, serve as a basis for identifying candidate waters for Section 303(d) listing. Biocriteria are based on three types of biological data, including: (1) aquatic macroinvertebrate community data; (2) fish community data; and, (3) a catch-all class referred to as “other biological data.”

In general, for interpretation of macroinvertebrate data where habitat assessment scores indicate habitat is less than 75 percent of reference or appropriate control stream scores, and in the absence of other data indicating impairment by a discrete pollutant, a water body judged to be impaired will be placed in Category 4C. When interpreting fish community data, a provisional multi-metric habitat index called the QCPH1 index is used to identify stream habitat in poor condition. The QCPH1 index separates adequate habitat from poor habitat using a 0.39 threshold value; whereby, QCPH1 scores < 0.39 indicate stream habitat is of poor quality, and scores greater than 0.39 indicate available stream habitat is adequate. In the absence of other data indicating impairment by a discrete pollutant, impaired fish communities with poor habitat will be placed in Category 4C. Additional information about QCPH1 is provided in the *Considerations for the Influence of Habitat Quality and Sample Representativeness* section.

The sections below describe the methods used to evaluate the three types of biological data (macroinvertebrate community, fish community, and other biological data), along with background information on the development and scoring of biological criteria, procedures for assessing biological data, methods used to ensure sample representativeness, and additional information used to aid in assessing biological data such as the weight of evidence approach.

Aquatic Macroinvertebrate Community Data

The department conducts aquatic macroinvertebrate assessments to determine macroinvertebrate community health as a function of water quality and habitat. The health of a macroinvertebrate community is directly related to water quality and habitat. Almost all macroinvertebrate evaluation consists of comparing the health of the community of the “target” to healthy macroinvertebrate communities from reference streams of the same general size and usually in the same Ecological Drainage Unit (EDU).

The department's approach to monitoring and evaluating aquatic macroinvertebrates is largely based on *Biological Criteria for Wadeable/Perennial Streams of Missouri* (MDNR 2002). This document provides the framework for numerical biological criteria (biocriteria) relevant to the protection of aquatic life use for wadeable streams in the state. Biocriteria were developed using wadeable reference streams that occur in specific EDUs as mapped by the Missouri Resource Assessment Partnership (reference Figure 1 below). For macroinvertebrates, the numerical biocriterion translator is expressed as a multiple metric index referred to as the MSCI. The MSCI includes four metrics: Taxa Richness (TR); Ephemeroptera, Plecoptera, and Trichoptera Taxa (EPTT); Biotic Index (BI); and the Shannon Diversity Index (SDI). These metrics are considered indicators of stream health, and change predictably in response to the environmental condition of a stream.

Metric values are determined directly from macroinvertebrate sampling. To calculate the MSCI, each metric is normalized to unitless values of 5, 3, or 1, which are then added together for a total possible score of 20. MSCI scores are divided into three levels of stream condition:

- Fully Biologically Supporting (16-20),
- Partially Biologically Supporting (10-14), and
- Non-Biologically Supporting (4-8).

Partially and Non-Biologically Supporting streams may be considered impaired and are candidates for Section 303(d) listing.

Missouri Ecological Drainage Units (EDUs) and Biological Reference Locations

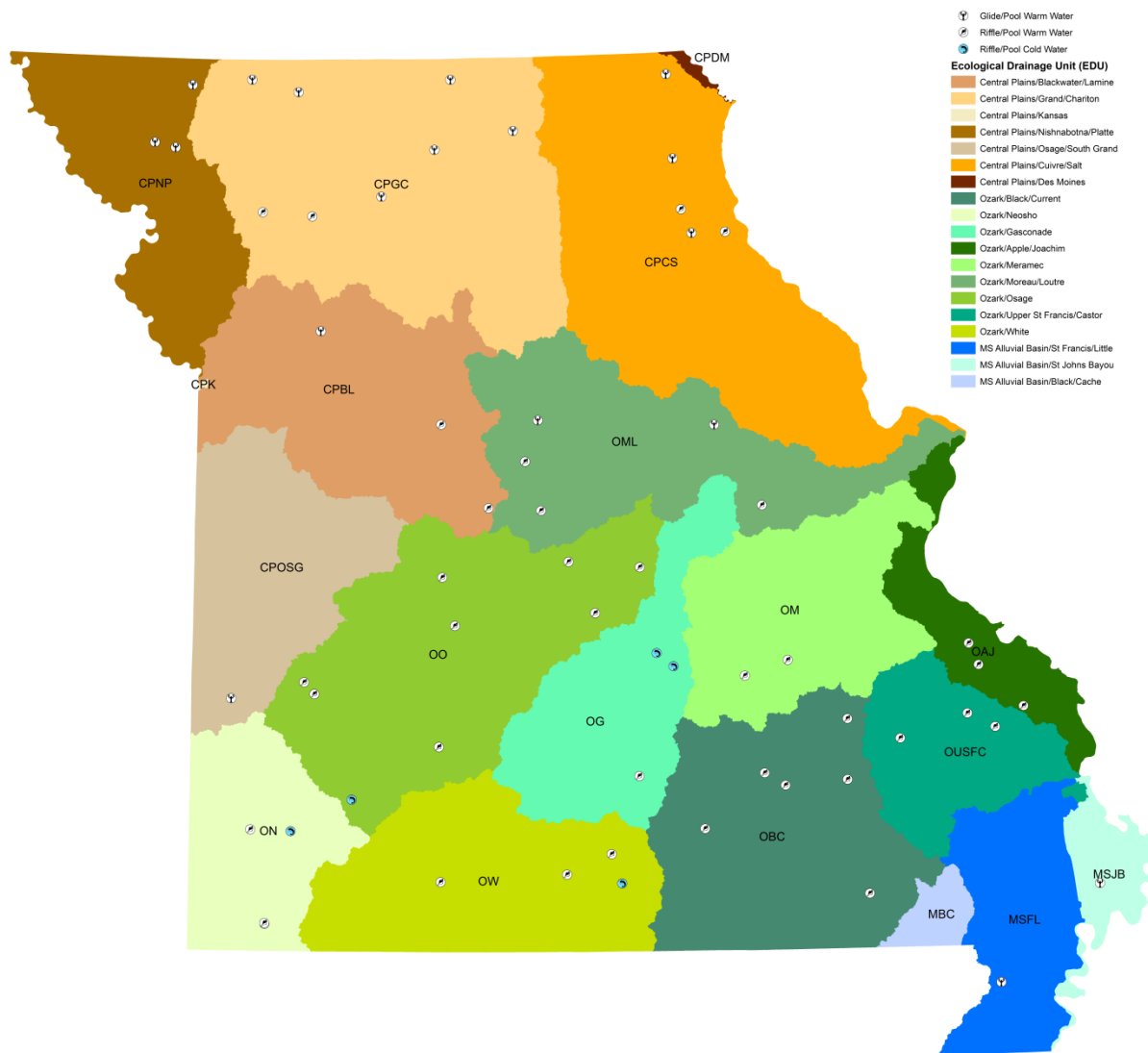


Figure 1: Missouri Ecological Drainage Units (EDUs) and Biological Reference Locations

Unitless metric values (5, 3, or 1) were developed from the lower quartile of the distribution of each metric as calculated from reference streams for each EDU. The lower quartile (25th percentile) of each metric equates to the minimum value still representative of unimpaired conditions. In operational assessments, metric values below the lower quartile of reference conditions are typically judged as impaired (United States Environmental Protection Agency 1996, Ohio Environmental Protection Agency 1990, Barbour *et al.* 1996). Moreover, using the 25th percentile of reference conditions for each metric as a standard for impairment allows natural variability to be filtered out. For metrics with values that decrease with increasing impairment (TR, EPTT, SDI), any value above the lower quartile of the reference distribution receives a score of five. For

the BI, whose value increases with increasing impairment, any value below the upper quartile (75th percentile) of the reference distribution receives a score of five. The remainder of each metric's potential quartile range below the lower quartile is bisected, and scored either a three or a one. If the metric value is less than or equal to the quartile value and greater than the bisection value it is scored a three. If the metric value is less than or equal to the bisection value it is scored a one.

MSCI scores meeting data quality considerations may be assessed for the protection of aquatic life using the following procedures.

Determining Full Attainment of Aquatic Life Use:

- For seven or fewer samples, 75% of the MSCI scores must be 16 or greater. Fauna achieving these scores are considered to be very similar to biocriteria reference streams.
- For eight or more samples, results must be statistically similar to representative reference or control streams.

Determining Non-Attainment of Aquatic Life Use:

- For seven or fewer samples, 75% of the MSCI scores must be 14 or lower. Fauna achieving these scores are considered to be substantially different from biocriteria reference streams.
- For eight or more samples, results must be statistically dissimilar to representative reference or control streams.

Data will be judged inconclusive when outcomes do not meet requirements for decisions of full or non-attainment.

As noted, when eight or more samples are available, results must be statistically similar or dissimilar to reference or control conditions in order to make an attainment decision. To accomplish this, a binomial probability with an appropriate level of significance (α =alpha), is calculated based on the null hypothesis that the test stream would have a similar percentage of MSCI scores that are 16 or greater as reference streams. The significance level is set at $\alpha=0.1$, meaning if the p-value of the hypothesis test is less than α , the hypothesis is considered statistically significant. The significance level of α is in fact the probability of making a wrong decision and committing a Type I error (rejecting a true null hypothesis). When the Type I error rate is less than $\alpha=0.1$, the null hypothesis is rejected. Inversely, when the Type I error rate is greater than $\alpha=0.1$, the null hypothesis is accepted. For comparing samples from a test stream to samples collected from reference streams in the same EDU, the percentage of samples from reference streams scoring 16 or greater is used to determine the probability of "success" and "failure" in the binomial probability equation. For example, if 84% of the reference stream MSCI scores in a particular EDU are 16 or greater, then 0.84 would be used as the probability of success and 0.16 would be used as the probability of failure. Note that Appendix D states to "rate a stream as impaired if biological criteria reference

stream frequency of fully biologically supporting scores is greater than five percent more than the test stream,” thus, a value of 0.79 (0.84 - 0.05) would actually be used as the probability of success in the binomial distribution equation.

Binomial Probability Example:

Reference streams from the Ozark/Gasconade EDU classified as riffle/pool stream types with warm water temperature regimes produce fully biologically supporting streams 85.7% of the time. In the test stream of interest, six out of ten samples resulted in MSCI scores of 16 or more. Calculate the Type I error rate for the probability of getting six or fewer fully biologically supporting scores in ten samples.

The binomial probability formula may be summarized as:

$$p^n + (n! / X!(n-X)! * p^n q^{n-X}) = 1$$

Where,

Sample Size (n) = 10

Number of Successes (X) = 6

Probability of Success (p) = 0.857 - 0.05 = 0.807

Probability of Failure (q) = 0.193

Binomial Distribution Coefficients = $n! / X!(n-X)!$

The equation may then be written as:

$$= 1 - ((0.807^{10}) + ((10 * (0.807^9) * (0.193))) + ((45 * (0.807^8) * (0.193^2)) + ((120 * (0.807^7) * (0.193^3))))$$

$$= 0.109$$

Since 0.109 is greater than the test significance level (minimum allowable Type I error rate) of $\alpha = 0.1$, we accept the null hypothesis that the test stream has the same percent of fully biologically supporting scores as the same type of reference streams from the Ozark/Gasconade EDU. Thus, this test stream would be judged as unimpaired.

If under the same scenario, there were only 5 samples from the test stream with MSCI scores of 16 or greater, the Type I error rate would change to 0.028, and since this value is less than the significance level of $\alpha = 0.1$, the stream would be judged as impaired.

Within each EDU, MSCI scores are categorized by sampling regime (Glide/Pool vs. Riffle/Pool) and temperature regime (warm water vs. cold water). The percentage of fully biologically supporting scores for the Mississippi River Alluvial Basin/Black/Cache EDU is not available due to the lack of reference sites in this region. Percentages of fully

biologically supporting samples per EDU is not included here, but can be made available upon request. The percentage of reference streams per EDU that are fully biologically supporting may change periodically as additional macroinvertebrate samples are collected and processed from reference samples within an EDU.

Sample Representativeness

The department's field and laboratory methods used to collect and process macroinvertebrate samples are contained in the document *Semi-Quantitative Macroinvertebrate Stream Bioassessment* (MDNR 2012a). Macroinvertebrates are identified to levels following standard operating procedures contained in *Taxonomic Levels for Macroinvertebrate Identifications* (MDNR 2012b). Macroinvertebrate monitoring is accompanied by physical habitat evaluations as described in the document *Stream Habitat Assessment* (MDNR 2010). For the assessment of macroinvertebrate samples, available information must meet data code levels three and four as described in Section II.C of this LMD. Data coded as levels three and four represent environmental data providing the greatest degree of assurance. Thus, at a minimum, macroinvertebrate assessments include multiple samples from a single site, or samples from multiple sites within a single reach.

It is important to avoid situations where poor or inadequate habitat prohibits macroinvertebrate communities from being assessed as fully biologically supporting. Therefore, when assessing macroinvertebrate samples, the quality of available habitat must be similar to that of reference streams within the appropriate EDU. The department's policy for addressing this concern has been to exclude MSCI scores from an assessment when accompanying habitat scores are less than 75 percent of the mean habitat scores from reference streams of the appropriate EDU. The following procedures outline the department's method for assessing macroinvertebrate communities from sites with poor or inadequate habitat.

Assessing Macroinvertebrate Communities from Poor/Inadequate Habitat:

- If less than half the macroinvertebrate samples in an assessed stream segment have habitat scores less than 75 percent of the mean score for reference streams in that EDU, any sample that scores less than 16 and has a habitat score less than 75 percent of the mean reference stream score for that EDU, is excluded from the assessment process.
- If at least half the macroinvertebrate samples in an assessed stream segment have habitat scores less than 75 percent of the mean score for reference streams in that EDU and the assessment results in a judgment that the macroinvertebrate community is impaired, the assessed segment will be placed in Category 4C impairment due to poor aquatic habitat.
- If one portion of the assessment reach contains two or more samples with habitat scores less than 75 percent of reference streams from that EDU while the remaining portion does not, the portion of the stream with poor habitat

scores could be separately assessed as a category 4C stream permitting low MSCI scores.

Macroinvertebrate sampling methods vary by stream type. One method is used in riffle/pool predominant streams, and the other method is for glide/pool predominant streams. For each stream type, macroinvertebrate sampling targets three habitats.

- For riffle/pool streams, the three habitats sampled are flowing water over coarse substrate, non-flowing water over depositional substrate, and rootmat substrate.
- For glide/pool streams, the three habitats sampled are non-flowing water over depositional substrate, large woody debris substrate, and rootmat substrate.

In some instances, one or more of the habitats sampled can be limited or missing from a stream reach, which may affect an MSCI score. Macroinvertebrate samples based on only two habitats may have an MSCI score equal to or greater than 16, but it is also possible that a missing habitat may lead to a decreased MSCI score. Although MDNR stream habitat assessment procedures take into account a number of physical habitat parameters from the sample reach (for example, riparian vegetation width, channel alteration, bank stability, bank vegetation protection, etc.), they do not exclusively measure the quality or quantity of the three predominant habitats from each stream. When evaluating potentially impaired macroinvertebrate communities, the number of habitats sampled, in addition to the stream habitat assessment score, will be considered to ensure MSCI scores less than 16 are properly attributed to poor water quality or poor/inadequate habitat condition.

Biologists responsible for conducting biological assessments will determine the extent to which habitat availability is responsible for a non-supporting (<16) MSCI score. If it is apparent that a non-supporting MSCI score was due to limited habitat, these effects will be stated in the biological assessment report. This limitation will then be considered when deciding which Listing Methodology category is most appropriate for an individual stream. This procedure, as part of an MDNR biological assessment, will aid in determining whether impaired macroinvertebrate samples have MSCI scores based on poor water quality conditions versus habitat limitations.

To ensure assessments are based on representative macroinvertebrate samples, samples collected during or shortly after prolonged drought, shortly after major flood events, or any other conditions that fall outside the range of environmental conditions under which reference streams in the EDU were sampled, will not be used to make an attainment decision for a Section 303(d) listing or any other water quality assessment purposes. Sample “representativeness” is judged by Water Protection Program (WPP) staff after reading the biomonitoring report for that stream, and if needed, consultation with biologists from the department’s Environmental Services Program. Regarding smaller deviations from “normal” conditions, roughly 20 percent of reference samples failing to meet a fully biologically supporting MSCI score were collected following weather/climate extremes; as a result, biological criteria for a given EDU are inclusive of samples collected during not

only ideal macroinvertebrate-rearing conditions, but also during the weather extremes that Missouri experiences.

Assessing Small Streams

Occasionally, macroinvertebrate monitoring is needed to assess streams smaller than the typical Wadeable/Perennial reference streams listed in Table I of Missouri's Water Quality Standards. Smaller streams may include Class C streams (streams that may cease flow in dry periods but maintain permanent pools which support aquatic life) or those that are unclassified. Assessing small streams involves comparing test stream and candidate reference stream MSCI scores first, to Wadeable/Perennial Reference Stream (WPRS) criteria, and second to each other. In MDNR's Biological Criteria Database, there are 16 candidate reference streams labeled as Class P, 23 labeled as Class C, and 24 labeled as Class U. In previous work by MDNR, when the MSCI was calculated according to WPRS criteria, the failure rate for such candidate reference streams was 31% for Class P, 39% for Class C, and 70% for Class U. The data trend showed a higher failure rate for increasingly smaller high quality streams when scored using WPRS biological criteria. This trend demonstrates the need to include the utilization of candidate reference streams in biological stream assessments.

For test streams that are smaller than Wadeable Perennial reference streams, MDNR also samples five candidate reference streams (small control streams) of same or similar size and Valley Segment Type (VST) in the same EDU twice during the same year the test stream is sampled (additional information about the selection small control streams is provided below). Although in most cases the MDNR samples small candidate reference streams concurrently with test streams, existing data may be used if a robust candidate reference stream data set exists for the EDU.

If the ten small candidate reference stream scores are similar to Wadeable Perennial reference stream criteria, then they and the test stream are considered to have a Class C or Class P general warm water beneficial use, and the MSCI scoring system in the LMD should be used. If the small candidate reference streams have scores lower than the Wadeable Perennial reference streams, the assumption is that the small candidate reference streams, and the test stream, represent designated uses related to stream size that are not yet approved by EPA in the state's water quality standards. The current assessment method for test streams that are smaller than reference streams is stated below.

- If the ten candidate reference stream (small control stream) scores are similar to WPRSs and meet LMD criteria for an unimpaired macroinvertebrate community, then the test stream will be assessed using MSCI based procedures in the LMD.
- If the ten candidate reference stream scores are lower than those of WPRSs and do not meet the LMD criteria for an unimpaired macroinvertebrate community, then:

- a) The test stream will be assessed as having an unimpaired macroinvertebrate community if the test stream scores meet the LMD criteria for an unimpaired community;
- b) The test stream data will be judged inconclusive if test stream scores are similar to candidate reference stream scores;
- c) The test stream will be assessed as having a “suspect” macroinvertebrate community if its scores are found to be low but statistically close to candidate reference streams; or,
- d) The test stream will be assessed as having an “impaired” macroinvertebrate community if its scores are found to be statistically lower than the candidate reference streams.

This method of assessing small streams will be used only until such time as the aquatic habitat protection use categories based on watershed size classifications of Headwater, Creek, Small River, Large River and Great River are promulgated into Missouri Water Quality Standards and appropriate biological metrics are established for stream size and permanence.

The approach for determining a “suspect” or “impaired” macroinvertebrate community will be made using a direct comparison between all streams being evaluated, which may include the use of percent and/or mean calculations as determined on a case by case basis. All work will be documented on the macroinvertebrate assessment worksheet and be made available during the public notice period.

Selecting Small Candidate Reference Streams

Accurately assessing streams that are smaller than reference streams begins with properly selecting small candidate reference streams. Candidate reference streams are smaller than WPRS streams and have been identified as “best available” reference stream segments in the same EDU as the test stream according to watershed, riparian, and in-channel conditions. The selection of candidate reference streams is consistent with framework provided by Hughes *et al.* (1986) with added requirements that candidate reference streams must be from the same EDU and have the same or similar values for VST parameters. If candidate reference streams perform well when compared to WPRS, then test streams of similar size and VST are expected to do so as well. VST parameters important for selection are based on temperature, stream size, flow, geology, and relative gradient, with emphasis placed on the first three parameters.

The stepwise process for candidate reference stream selection is listed below.

- 1. Determine test stream reaches to be assessed.
- 2. Identify appropriate EDU.
- 3. Determine five variable VST of test stream segments (1st digit = temperature; 2nd digit = size; 3rd digit = flow; 4th digit = geology; and 5th digit = relative gradient).

4. Filter all stream segments within the same EDU for the relevant five variable VSTs (1st and 2nd digits especially critical for small streams).
5. Filter all potential VST stream segments for stressors against available GIS layers (e.g. point source, landfills, CAFOs, lakes, reservoirs, mining, etc.).
6. Filter all potential VST stream segments against historical reports and databases.
7. Develop candidate stream list with coordinates for field verification.
8. Field verify candidate list for actual use (e.g. animal grazing, in-stream habitat, riparian habitat, migration barriers (e.g. culverts, low water bridge crossings) representativeness, gravel mining, and other obvious human stressors).
9. Rank order candidate sites, eliminate obvious stressed sites, and select at least top five sites.
10. Calculate land use-land cover and compare to EDU.
11. Collect chemical, biological, habitat, and possibly sediment field data.
12. After multiple sampling events evaluate field data, land use, and historical data in biological assessment report.
13. If field data are satisfactory, retain candidate reference stream label in database.

Fish Community Data

The department utilizes fish community data to determine if aquatic life use is supported in certain types of Missouri streams. When properly evaluated, fish communities serve as important indicators of stream health. In Missouri, fish communities are surveyed by the MDC. MDC selects an aquatic subregion to sample each year, and therein, surveys randomly selected streams of 2nd to 5th order in size. Fish sampling follows procedures described in the document *Resource Assessment and Monitoring Program: Standard Operational Procedures--Fish Sampling* (Combes 2011). Numeric biocriteria for fish are represented by the fish Index of Biotic Integrity (fIBI). Development of the fIBI is described in the document *Biological Criteria for Stream Fish Communities of Missouri* (Doisy *et al.* 2008).

The fIBI is a multi-metric index made up of nine individual metrics, which include:

- number (#) of native individuals;
- # of native darter species;
- # of native benthic species;
- # of native water column species;
- # of native minnow species;
- # of all native lithophilic species;
- percentage (%) of native insectivore cyprinid individuals;
- % of native sunfish individuals; and,
- % of the three top dominant species.

Values for each metric, as directly calculated from the fish community sample, are converted to unitless scores of 1, 3, or 5 according to criteria in Doisy *et al.* (2008). The fIBI is then calculated by adding these unitless values together for a total possible score of 45. Doisy *et al.* (2008) established an impairment threshold of 36 (where the 25th percentile of reference sites represented a score of 37), with values equal to or greater than 36 representing unimpaired communities, and values less than 36 representing impaired communities. For more information regarding fIBI scoring, please see Doisy *et al.* (2008).

Based on consultation between the department and MDC, the fIBI impairment threshold value of 36 was used as the numeric biocriterion translator for making an attainment decision for aquatic life (Appendix C). Work by Doisy *et al.* (2008) focused on streams 3rd to 5th order in size, and the fIBI was only validated for streams in the Ozark ecoregion, not for streams in the Central Plains and Mississippi Alluvial Basin. Therefore, when assessing streams with the fIBI, the index may only be applied to streams 3rd to 5th order in size from the Ozark ecoregion. Assessment procedures are outlined below.

Full Attainment

- For seven or fewer samples and following MDC RAM fish community protocols, 75% of fIBI scores must be 36 or greater. Fauna achieving these scores are considered to be very similar to Ozark reference streams.
- For eight or more samples, the percent of samples scoring 36 or greater must be statistically similar to representative reference or control streams. To determine statistical similarity, a binomial probability Type I error rate (0.1) is calculated based on the null hypothesis that the test stream would have the same percentage (75%) of fIBI scores greater than 36 as reference streams. If the Type I error rate is more than the significance level $\alpha=0.1$, the fish community would be rated as unimpaired.

Non-Attainment

- For seven or fewer samples and following MDC RAM fish community protocols, 75% of the fIBI scores must be lower than 36. Fauna achieving these scores are considered to be substantially different than regional reference streams.
- For eight or more samples, the percent of samples scoring 36 or less must be statistically dissimilar to representative reference or control streams. To determine statistical dissimilarity, a binomial probability Type I error rate is calculated based on the null hypothesis that the test stream would have the same percentage (75%) of fIBI scores greater than 36 as reference streams. If the Type I error rate is less than 0.1, the null hypothesis is rejected and the fish community would be rated as impaired.

Data will be judged inconclusive when outcomes do not meet requirements for decisions of full or non-attainment.

With the exception of two subtle differences, use of the binomial probability for fish community samples will follow the example provided for macroinvertebrate samples in the previous section. First, instead of test stream samples being compared to reference streams of the same EDU, they will be compared to reference streams from the Ozark ecoregion. Secondly, the probability of success used in the binomial distribution equation will always be set to 0.70 since Appendix D states to “rate a stream as impaired if biological criteria reference stream frequency of fully biologically supporting scores is greater than five percent more than the test stream.”

Although 1st and 2nd order stream data will not be used to judge a stream as impaired for Section 303(d) purposes, the department may use the above assessment procedures to judge 1st and 2nd order streams as unimpaired. Moreover, should samples contain fIBI scores less than 29, the department may judge the stream as “suspected of impairment” using the above procedures.

Considerations for the Influence of Habitat Quality and Sample Representativeness

Low fIBI scores that are substantially different than reference streams could be the result of water quality problems, habitat problems, or both. When low fIBI scores are established, it is necessary to review additional information to differentiate between an impairment caused by water quality and one that is caused by habitat. The collection of a fish community sample is also accompanied by a survey of physical habitat from the sampled reach. MDC sampling protocol for stream habitat follows procedures provided by Peck *et al.* (2006). With MDC guidance, the department utilizes this habitat data and other available information to assure that an assessment of aquatic life attainment based on fish data is only the result of water quality, and that an impairment resulting from habitat is categorized as such. This section describes the procedures used to assure low fIBI scores are the result of water quality problems and not habitat degradation. The information below outlines the department’s provisional method to identify unrepresentative samples and low fIBI scores with questionable habitat condition, and ensure corresponding fish IBI scores are not used for Section 303(d) listing.

- a) Following recommendations from the biocriteria workgroup, the department will consult MDC about the habitat condition of particular streams when assessing low fIBI scores.
- b) Samples may be considered for Section 303(d) listing ONLY if they were collected in the Ozark ecoregion, and the samples were collected during normal representative conditions, based upon best professional judgment from MDC staff,. Samples collected from the Central Plains and Mississippi Alluvial Basin are excluded from Section 303(d) listing.
- c) Only samples from streams 3rd to 5th order in size may be considered for Section 303(d) listing. Samples from 1st or 2nd order stream sizes are excluded from Section 303(d) consideration; however, they may be placed

into Categories 2B and 3B if impairment is suspected, or into Categories 1, 2A, or 3A if sample scores indicate a stream is unimpaired. Samples from lower stream orders are surveyed under a different RAM Program protocol than 3rd to 5th order streams.

- d) Samples that are ineligible for Section 303(d) listing include those collected from losing streams, as defined by the Department of Geology and Land Survey, or collected in close proximity to losing streams. Additionally, ineligible samples may include those collected on streams that were considered to have natural flow issues (such as streams reduced predominately to subsurface flow) preventing good fish IBI scores from being obtained, as determined through best professional judgment of MDC staff.
- e) Fish IBI scores must be accompanied by habitat samples with a QCPH1 habitat index score. MDC was asked to analyze meaningful habitat metrics and identify samples where habitat metrics seemed to indicate potential habitat concerns. As a result, a provisional index named QCPH1 was developed. QCPH1 values less than 0.39 indicate poor habitat, and values greater than 0.39 suggest adequate habitat is available. The QCPH1 comprises six sub-metrics indicative of substrate quality, channel disturbance, channel volume, channel spatial complexity, fish cover, and tractive force and velocity.

The QCPH1 index is calculated as follows:

$$\text{QCPH1} = ((\text{Substrate Quality} * \text{Channel Disturbance} * \text{Channel Volume} * \text{Channel Spatial Complexity} * \text{Fish Cover} * \text{Tractive Force \& Velocity})^{1/6})$$

Where sub-metrics are determined by:

$$\text{Substrate Quality} = [(\text{embeddedness} + \text{small particles})/2] * [(\text{filamentous algae} + \text{aquatic macrophyte})/2] * \text{bedrock and hardpan}$$

$$\text{Channel Disturbance} = \text{concrete} * \text{riprap} * \text{inlet/outlet pipes} * \text{relative bed stability} * \text{residual pool observed to expected ratio}$$

$$\text{Channel Volume} = [(\text{dry substrate} + \text{width depth product} + \text{residual pool} + \text{wetted width})/4]$$

$$\text{Channel Spatial Complexity} = (\text{coefficient of variation of mean depth} + \text{coefficient of variation of mean wetted width} + \text{fish cover variety})/3$$

Fish Cover = [(all natural fish cover + ((brush and overhanging vegetation + boulders + undercut bank + large woody debris)/4) + large types of fish cover)/3]

Tractive Force & Velocity = [(mean slope + depth * slope)/2]

Unimpaired fish IBI samples ($fIBI \geq 36$) with QCPH1 index scores below the 0.39 threshold value, or samples without a QCPH1 score altogether, are eliminated from consideration for Category 5 and instead placed into Categories 2B or 3B should an impairment be suspected. Impaired fish communities ($fIBI < 36$) with QCPH1 scores < 0.39 can be placed into Category 4C (non-discrete pollutant/habitat impairment). Impaired fish communities ($fIBI < 36$) with adequate habitat scores ($QCPH1 > 0.39$) can be placed into Category 5. Appropriate streams with unimpaired fish communities and adequate habitat ($QCPH1 > 0.39$) may be used to judge a stream as unimpaired.

Similar to macroinvertebrates, assessment of fish community information must be based on data coded level three or four as described in Section II.C of this document. Data coded as levels three and four represent environmental data with the greatest degree of assurance, and thus, assessments will include multiple samples from a single site, or samples from multiple sites within a single reach.

Following the department's provisional methodology, fish community samples available for assessment (using procedures in Appendix C & D include only those from 3rd to 5th order Ozark Plateau streams, collected under normal, representative conditions, where habitat seemed to be good, and where there were no issues with inadequate flow or water volume.

- Other Biological Data

On a case by case basis, the department may use biological data other than MSCI or $fIBI$ scores for assessing attainment of aquatic life. Other biological data may include information on single indicator aquatic species that are ecologically or recreationally important, or individual measures of community health that respond predictably to environmental stress. Measures of community health could be represented by aspects of structure, composition, individual health, and processes of the aquatic biota. Examples could include measures of density or diversity of aquatic organisms, replacement of pollution intolerant taxa, or even the presence of biochemical markers.

Other biological data should be collected under a well vetted study that is documented in a scientific report, a weight of evidence approach should be established, and the report should be referenced in the 303(d) listing worksheet. If other biological data is a critical component of the community and has been adversely affected by the presence of a pollutant or stressor, then such data would indicate a water body is impaired. The department's use of other biological data is consistent with EPA's policy on independent applicability for making attainment decisions, which is intended to protect against dismissing valuable information when diagnosing an impairment of aquatic life.

The use of other biological data in water body assessments occurs infrequently, but when available, it is usually assessed in combination with other information collected within the water body of interest. The department will avoid using other biological data as the sole justification for a Section 303(d) listing; however, other biological data will be used as part of a weight of evidence analysis for making the most informed assessment decision.

- Toxic Chemicals

Water

For the interpretation of toxicity test data, standard acute or chronic bioassay procedures using freshwater aquatic fauna such as, but not limited to, *Ceriodaphnia dubia*, Fathead Minnows (*Pimephales promelas*), *Hyalella azteca*, or Rainbow Trout (*Oncorhynchus mykiss*)¹⁸ will provide adequate evidence of toxicity for 303(d) listing purposes. Microtox[®] toxicity tests may be used to list a water as affected by “toxicity” only if there are data of another kind (freshwater toxicity tests, sediment chemistry, water chemistry, or biological sampling) that indicate water quality impairment.

For any given water, available data may occur throughout the system and/or be concentrated in certain areas. When the location of pollution sources are known, the department reserves the right to assess data representative of impacted conditions separately from data representative of unimpacted conditions. Pollution sources include those that may occur at discrete points along a water body, or those that are more diffuse.

Sediment

For toxic chemicals occurring in benthic sediments, data interpretation will include calculation of a geometric mean for specific toxins from an adequate number of samples, and comparing that value to a corresponding Probable Effect Concentration (PEC) given by MacDonald *et al.* (2000). The PEC is the level of a pollutant above which harmful effects on the aquatic community are likely to be observed. MacDonald (2000) gave an estimate of accuracy for the ability of individual PECs to predict toxicity. For all metals except arsenic, pollutant geometric means will be compared to 150% of the recommended PEC values. This comparison should meet confidence requirements applied elsewhere in this document. When multiple contaminants occur in sediment, toxicity may occur even though the level of each individual pollutant does not reach toxic levels. The method of estimating the synergistic effects of multiple pollutants in sediments is described below.

The Meaning of the Sediment Quotient and How to Calculate It

Although sediment criteria in the form of a PEC are given for several individual contaminants, it is recognized that when multiple contaminants occur in sediment, toxicity may occur even though the level of each individual pollutant does not reach toxic levels. The method of estimating the synergistic effects of multiple pollutants in sediments given in MacDonald *et al.* (2000) includes the calculation of a PECQ. PECQs greater than 0.75 will be judged as toxic.

¹⁸ Reference 10 CSR 20-7.015(9)(L) for additional information

This calculation is made by dividing the pollutant concentration in the sample by the PEC value for that pollutant. For single samples, the quotients are summed, and then normalized by dividing that sum by the number of pollutants in the formula. When multiple samples are available, the geomean (as calculated for specific pollutants) will be placed in the numerator position for each pollutant included in the equation.

Example: A sediment sample contains the following results in mg/kg:

Arsenic 2.5, Cadmium 4.5, Copper 17, Lead 100, and Zinc 260.

The PEC values for these five pollutants in respective order are:

33, 4.98, 149, 128, and 459 mg/kg.

PECQ =

$$[(2.5/33) + (4.5/4.98) + (17/149) + (100/128) + (260/459)]/5 = 0.488$$

Using PECQ to Judge Toxicity

Based on research by MacDonald *et al.* (2000) 83% of sediment samples with PECQ less than 0.5 were non-toxic while 85% of sediment samples with PECQ greater than 0.5 were toxic.

Therefore, to accurately assess the synergistic effects of sediment contaminants on aquatic life, the department will judge PECQ greater than 0.75 as toxic.

- Duration of Assessment Period.

Except where the assessment period is specifically noted in Appendix B, the time period during which data will be used in making the assessments will be determined by data age and data code considerations, as well as representativeness considerations such as those described in footnote 14.

- Assessment of Tier Three Waters

Waters given Tier Three protection by the antidegradation rule at 10 CSR 20-7.031(2) shall be considered impaired if data indicate water quality has been reduced in comparison to its historical quality. Historical quality is determined from past data that best describes a water body's water quality following promulgation of the antidegradation rule and at the time the water was given Tier Three protection.

Historical data gathered at the time waters were given Tier Three protection will be used if available. Because historical data may be limited, the historical quality of the waters may be determined by comparing data from the assessed segment with data from a "representative" segment. A representative segment is a body or stretch of water that best

reflects the conditions that probably existed at the time the antidegradation rule first applied to the waters being assessed. Examples of possible representative data include 1) data from stream segments upstream of assessed segments that receive discharges, and 2) data from other water bodies in the same ecoregion having similar watershed and landscape characters. These representative stream segments also would be characterized by receiving discharges similar to the quality and quantity of historic discharges of the assessed segment. The assessment may also use data from the assessed segment gathered between the time of the initiation of Tier Three protection and the last known time in which upstream discharges, runoff, and watershed conditions remained the same, provided that the data do not show any significant trends of declining water quality during that period.

The data used in the comparisons will be tested for normality and an appropriate statistical test will be applied. The null hypothesis for statistical analysis will be that water quality at the test segment and representative segment is the same. This will be a one-tailed test (the test will consider only the possibility that the assessed segment has poorer water quality) with the alpha level of 0.1, meaning that the test must show greater than a 90 percent probability that the assessed segment has poorer water quality than the representative segment before the assessed segment can be listed as impaired.

- Other Types of Information

1. Observation and evaluation of waters for noncompliance with state narrative water quality criteria. Missouri's narrative water quality criteria, as described in 10 CSR 20-7.031 Section (3), may be used to evaluate waters when a quantitative (narrative) value can be applied to the pollutant. These narrative criteria apply to both classified and unclassified waters and prohibit the following in waters of the state:
 - a. Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly, or harmful bottom deposits or prevent full maintenance of beneficial uses;
 - b. Waters shall be free from oil, scum, and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses;
 - c. Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor, or prevent full maintenance of beneficial uses;
 - d. Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal, or aquatic life;
 - e. There shall be no significant human health hazard from incidental contact with the water;
 - f. There shall be no acute toxicity to livestock or wildlife watering;
 - g. Waters shall be free from physical, chemical, or hydrologic changes that would impair the natural biological community;
 - h. Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment, and solid waste as defined in Missouri's Solid Waste

Law, section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to sections 260.200–260.247, RSMo;

2. Habitat assessment protocols for wadeable streams have been established and are conducted in conjunction with sampling aquatic macroinvertebrates and fish. Methods for evaluating aquatic macroinvertebrate and fish community data include assessment procedures that account for the presence or absence of representative habitat quality. The department will not use habitat data alone for assessment purposes.

E. Other 303(d) Listing Considerations

- Adding to the Existing List or Expanding the Scope of Impairment to a Previously Listed Water.

The listed portion of impaired water bodies may be increased based on recent monitoring data following the guidelines in this document. One or more new pollutants may be added to the listing for a water body already on the list based on recent monitoring data following these same guidelines. Waters not previously listed may be added to the list following the guidelines in this document.

- Deleting from the Existing List or Decreasing the Scope of Impairment to a Previously Listed Water

The listed portion of an impaired water body may be decreased based on recent monitoring data following the guidelines in this document. One or more pollutants may be deleted from the listing for a water body already on the list based on recent monitoring data following guidelines in Appendix D. Waters may be completely removed from the list for several reasons¹⁹, the most common being (1) water has returned to compliance with water quality standards, or (2) the water has an approved TMDL study or Permit in Lieu of a TMDL.

F. Prioritization of Waters for TMDL Development

Section 303(d) of the Clean Water Act and federal regulation 40 CFR 130.7(b)(4) require states to submit a priority ranking of waters requiring TMDLs. The department will prioritize development of TMDLs based on several variables including:

- social impact/public interest and risk to public health
- complexity and cost (including consideration of budget constraints), availability of data of sufficient quality and quantity for TMDL modeling
- court orders, consent decrees, or other formal agreements
- source of impairments
- existence of appropriate numeric quality criteria, and
- implementation potential and amenability of the problem to treatment

¹⁹ See, “Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act”. USEPA, Office of Water, Washington DC.

The department's TMDL schedule will represent its prioritization. The TMDL Program develops the TMDL schedule and maintains it at the following website:

<http://www.dnr.mo.gov/env/wpp/tmdl/>.

G. Resolution of Interstate/International Disagreements

The department will review the draft 303(d) Lists of all other states with which it shares a border (Missouri River, Mississippi River, Des Moines River and the St. Francis River) or other interstate waters. Where the listing for the same water body in another state is different than the one in Missouri, the department will request the data and the listing justification. These data will be reviewed following the evaluation guidelines in this document. The Missouri Section 303(d) list may be changed pending the evaluation of this additional data.

H. Statistical Considerations

The most recent EPA guidance on the use of statistics in the 303(d) listing methodology document is given in Appendix A. Within this guidance there are three major recommendations regarding statistics:

- Provide a description of analytical tools the state uses under various circumstances
 - When conducting hypothesis testing, explain the various circumstances under which the burden of proof is placed on proving the water is impaired and when it is placed on proving the water is unimpaired, and
 - Explain the level of statistical significance (α) used under various circumstances.
- Description of Analytical Tools

Appendix D, describes the analytical tools the department will use to determine whether a water body is impaired and whether or when a listed water body is no longer impaired.

- Rationale for the Burden-of-Proof

Hypothesis testing is a common statistical practice. The procedure involves first stating a hypothesis you want to test, such as “the most frequently seen color on clothing at a St. Louis Cardinals game is red” and then the opposite or null hypothesis “red is not the most frequently seen color on clothing at a Cardinals game.” Then a statistical test is applied to the data (a sample of the predominant color of clothing worn by 200 fans at a Cardinals game on July 12) and based on an analysis of that data, one of the two hypotheses is chosen as correct.

In hypothesis testing, the burden-of-proof is always on the alternate hypothesis. In other words, there must be very convincing data to make us conclude that the null hypothesis is not true and that we must accept the alternate hypothesis. How convincing the data must be is stated as the “significance level” of the test. A significance level of $\alpha=0.10$ means that there must be at least a 90 percent probability that the alternate hypothesis is true before we can accept it and reject the null hypothesis.

For analysis of a specific kind of data, either the test significance level or the statement of null and alternative hypotheses, or both, can be varied to achieve the desired degree of statistical rigor. The department has chosen to maintain a consistent set of null and alternate hypotheses for all our statistical procedures. The null hypothesis will be that the water body in question is unimpaired and the alternate hypothesis will be that it is impaired. Varying the level of statistical rigor will be accomplished by varying the test significance level. For determining impairment (Appendix D) test significance levels are set at either $\alpha=0.1$ or $\alpha=0.4$, meaning the data must show at minimum 90% or 60% probability, respectively that the water body is impaired. However, if the department retained these same test significance levels in determining when an impaired water body had been restored to an unimpaired status (Appendix D) some undesirable results can occur.

For example, using a 0.1 significance level for determining both impairment and non-impairment, if the sample data indicate the stream had a 92 percent probability of being impaired, it would be rated as impaired. If subsequent data were collected and added to the database, and the data now showed the water had an 88 percent chance of being impaired, it would be rated as unimpaired. Judging as unimpaired a water body with only a 12 percent probability of being unimpaired is clearly a poor decision. To correct this problem, the department will use a test significance level of 0.4 for some analytes and 0.6 for others. This will increase our confidence in determining compliance with criteria to 40 percent and 60 percent, respectively under the worst case conditions, and for most databases will provide an even higher level of confidence.

- Level of Significance Used in Tests

The choice of significance levels is largely related to two concerns. The first concern is with matching error rates with the severity of the consequences of making a decision error. The second addresses the need to balance, to the degree practicable, Type I and Type II error rates. For relatively small number of samples, the disparity between Type I and Type II errors can be large. The tables 2.0 and 3.0 below shows error rates calculated using the binomial distribution for two very similar situations. Type I error rates are based on a stream with a 10 percent exceedence rate of a standard, and Type II error rates are based on a stream with a 15 percent exceedence rate of a standard. Note that when sample size remains the same, Type II error rates increase as Type I error rates decrease (Table 2.0). Also note that for a given Type I error rate, the Type II error rate declines as sample size increases (Table 3.0).

Table 2.0. Effects of Type I error rates on Type II error rates. Type I error rates are based on a stream with a 10 percent exceedence rate of a standard and Type II error rates for a stream with a 15 percent exceedence rate of a standard.

Total No. of Samples	No. Samples Meeting Std.	Type I Error Rate	Type II Error Rate
18	17	0.850	0.479
18	16	0.550	0.719
18	15	0.266	0.897
18	14	0.098	0.958
18	13	0.028	0.988

Table 3.0. Effects of Type I error rates and sample size on Type II error rates. Type I error rates are based on a stream with a 10 percent exceedence rate of a standard and Type II error rates for a stream with a 15 percent exceedence rate of a standard.

Total No. of Samples	No. Samples Meeting Std.	Type I Error Rate	Type II Error Rate
6	5	0.469	0.953
11	9	0.303	0.930
18	15	0.266	0.897
25	21	0.236	0.836

- Use of the Binomial Probability Distribution for Interpretation of the 10 Percent Rule

There are two options for assessing data for compliance with the 10 percent rule. One is to simply calculate the percent of time the criterion value is not met, and to judge the water to be impaired if this value is greater than 10 percent. The second method is to use some evaluative procedure that can review the data and provide a probability statement regarding compliance with the 10 percent rule. Since the latter option allows assessment decisions relative to specific

test significance levels and the first option does not, the latter option is preferred. The procedure chosen is the binomial probability distribution and calculation of the Type I error rate.

- Other Statistical Considerations

Prior to calculation of confidence limits, the normality of the data set will be evaluated. If normality is improved by a data transformation, the confidence limits will be calculated on the transformed data.

Time of sample collection may be biased and interfere with an accurate measurement of frequency of exceedance of a criterion. Data sets composed mainly or entirely of storm water data or data collected only during a season when water quality problems are expected could result in a biased estimate of the true exceedance frequency. In these cases, the department may use methods to estimate the true annual frequency and display these calculations whenever they result in a change in the impairment status of a water body.

For waters judged to be impaired based on biological data where data evaluation procedures are not specifically noted in Table 1, the statistical procedure used, test assumptions, and results will be reported.

- Examples of Statistical Procedures

Two Sample “t” Test for Color

Null Hypothesis: Amount of color is no greater in a test stream than in a control stream. As stated, this is a one-sided test, meaning that we are only interested in determining whether or not the color level in the test stream is greater than in a control stream. If the null hypothesis had been “amount of color is different in the test and control streams,” we would have been interested in determining if the amount of color was either less than or greater than the control stream, a two-sided test.

Significance Level: $\alpha=0.10$

Data Set: Platinum-Cobalt color units data for the test stream and a control stream samples collected at each stream on same date.

Test Stream	70	45	35	45	60	60	80
Control Stream	50	40	20	40	30	40	75
Difference (T-C)	20	5	15	5	30	20	5

Statistics for the Difference: Mean = 14.28, standard deviation = 9.76, $n = 7$

Calculated “t” value = (square root of n)(mean)/standard deviation = 3.86

Tabular “t” value is taken from a table of the “t” distribution for 2 alpha (0.20) and $n-1$ degrees of freedom. Tabular “t” = 1.44.

Since calculated “t” value is greater than tabular t value, reject the null hypothesis and conclude that the test stream is impaired by color.

Statistical Procedure for Mercury in Fish Tissue

Data Set: data in $\mu\text{g/Kg}$ 130, 230, 450. Mean = 270, Standard Deviation = 163.7
The 60% Lower Confidence Limit Interval = the sample mean minus the quantity:
 $((0.253)(163.7)/\text{square root } 3) = 23.9$. Thus the 60% LCL Confidence Interval is 246.088 $\mu\text{g/Kg}$.

The criterion value is 300 $\mu\text{g/Kg}$. Therefore, since the 60% LCL Confidence Interval is less than the criterion value, the water is judged to be unimpaired by mercury in fish tissue, and the water body is placed in either Category 2B or 3B.

I. References

- Barbour, M.T., J. Gerritsen, G.E. Griffith, R. Frydenborg, E. McCarron, J.S. White, M.L. Bastian. 1996. A framework for biological criteria for Florida streams using benthic macroinvertebrates. *Journal of the North American Benthological Society* 15(2): 185-211.
- Doisy, K.E., C.F. Rabeni, M.D. Combes, and R.J. Sarver. 2008. Biological Criteria for Stream Fish Communities of Missouri. Final Report to the United States Environmental Protection Agency. Missouri Cooperative Fish and Wildlife Research Unit, Columbia, Missouri. 91 pp.
- Hughes, R.M., D.P. Larsen, and J.M. Omernik. 1986. Regional reference sites: a method for assessing stream pollution. *Environmental Management* 10(5): 625-629.
- Ohio Environmental Protection Agency. 1990. The Use of Biocriteria in the Ohio EPA Surface Water Monitoring and Assessment Program. Columbus, Ohio.
- Fischer, S. and M. Combes. 2011. Resource Assessment and Monitoring Program: Standard Operating Procedures – Fish Sampling. Missouri Department of Conservation, Jefferson City, Missouri.
- MacDonald, D.D, Ingersoll, C. G., Berger, T. A. *et al.* 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. *Arch. Environ. Contamination Toxicology*. 39, 20-31.
- Missouri Department of Natural Resources. 2002. Biological Criteria for Wadeable/Perennial Streams of Missouri. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 32 pp.
- Missouri Department of Natural Resources. 2010. Stream Habitat Assessment. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 40 pp.
- Missouri Department of Natural Resources. 2012a. Semi-Quantitative Macorinvertebrate Stream Bioassessment. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 29 pp.
- Missouri Department of Natural Resources. 2014 (recertification). Taxonomic Levels for Macroinvertebrate Identifications. Division of Environmental Quality, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 39 pp.
- Peck, D.V., A.T. Herlihy, B.H. Hill, R.M. Hughes, P.R. Kaufmann, D.J. Klemm, J.M. Lazorchak, F.H. McCormick, S.A. Peterson, P.L. Ringold, T. Magee, and M.Cappaert. 2006. Environmental Monitoring and Assessment Program-Surface Waters Western Pilot Study: Field Operation Manual for Wadeable Streams. EPA/620/R-06/003. U.S.

Environmental Protection Agency, Office of Research and Development, Washington, D.C.

U.S. Environmental Protection Agency. 1996. Biological Criteria: Technical Guidance for Streams and Small Rivers. EPA 822-B-96-001. Office of Water, Washington D.C. 162 pp.

Appendix A

Excerpt from *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act*. July 29, 2005. USEPA pp. 39-41.

The document can be read in its entirety from the US. EPA web site:

<http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/2006irg-report.pdf>

G. How should statistical approaches be used in attainment determinations?

The state's methodology should provide a rationale for any statistical interpretation of data for the purpose of making an assessment determination.

Description of statistical methods to be employed in various circumstances

The methodology should provide a clear explanation of which analytic tools the state uses and under which circumstances. EPA recommends that the methodology explain issues such as the selection of key sample statistics (arithmetic mean concentration, median concentration, or a percentile), null and alternative hypotheses, confidence intervals, and Type I and Type II error thresholds. The choice of a statistic tool should be based on the known or expected distribution of the concentration of the pollutant in the segment (e.g., normal or log normal) in both time and space.

Past EPA guidance (1997 305(b) and 2000 CALM) recommended making non-attainment decisions, for "conventional pollutants"²⁰ — TSS, pH, BOD, fecal coliform bacteria, and oil and grease¹³ — when more than "10% of measurements exceed the water quality criterion." (However, EPA guidance has not encouraged use of the "10% rule" with other pollutants, including toxics.) Use of this rule when addressing conventional pollutants, is appropriate if its application is consistent with the manner in which applicable WQC are expressed. An example of a WQC for which an assessment based on the ten percent rule would be appropriate is the EPA acute WQC for fecal coliform bacteria, applicable to protection of water contact recreational use. This 1976-issued WQC was expressed as, "...no more than ten percent of the samples exceeding 400 CFU per 100 ml, during a 30-day period." Here, the assessment methodology is clearly reflective of the WQC.

On the other hand, use of the ten percent rule for interpreting water quality data is usually not consistent with WQC expressed either as: 1) instantaneous maxima not to be surpassed at any time, or 2) average concentrations over specified times. In the case of "instantaneous maxima (or minima) never to occur" criteria use of the ten percent rule typically leads to the belief that segment conditions are equal or better than specified by the WQC, when they in fact are considerably worse. (That is,

²⁰ There are a variety of definitions for the term "conventional pollutants." Wherever this term is referred to in this guidance, it means "a pollutant other than a toxic pollutant."

pollutant concentrations are above the criterion-concentration a far greater proportion of the time than specified by the WQC.) Conversely, use of this decision rule in concert with WQC expressed as average concentrations over specific times can lead to concluding that segment conditions are worse than WQC, when in fact they are not.

If the state applies different decision rules for different types of pollutants (e.g., toxic, conventional, and non-conventional pollutants) and types of standards (e.g., acute vs. chronic criteria for aquatic life or human health), the state should provide a reasonable rationale supporting the choice of a particular statistical approach to each of its different sets of pollutants and types of standards.

- 1. Elucidation of policy choices embedded in selection of particular statistical approaches and use of certain assumptions EPA strongly encourages states to highlight policy decisions implicit in the statistical analysis that they have chosen to employ in various circumstances. For example, if hypothesis testing is used, the state should make its decision-making rules transparent by explaining why it chose either “meeting WQS” or “not meeting WQS” as the null hypothesis (rebuttable presumption) as a general rule for all waters, a category of waters, or an individual segment. Starting with the assumption that a water is “healthy” when employing hypothesis testing means that a segment will be identified as impaired, and placed in Category 4 or 5, only if substantial amounts of credible evidence exist to refute that presumption. By contrast, making the null hypothesis “WQS not being met” shifts the burden of proof to those who believe the segment is, in fact, meeting WQS.*

Which “null hypothesis” a state selects could likely create contrasting incentives regarding support for additional ambient monitoring among different stakeholders. If the null hypothesis is “meeting standards,” there were no previous data on the segment, and no additional existing and readily available data and information are collected, then the “null hypothesis” cannot be rejected, and the segment would not be placed in Category 4 or 5. In this situation, those concerned about possible adverse consequences of having a segment declared “impaired” might have little interest in collection of additional ambient data. Meanwhile, users of the segment would likely want to have the segment monitored, so they can be ensured that it is indeed capable of supporting the uses of concern. On the other hand, if the null hypothesis is changed to “segment not meeting WQS,” then those that would prefer that a particular segment not be labeled “impaired” would probably want more data collected, in hopes of proving that the null hypothesis is not true.

Another key policy issue in hypothesis testing is what significance level to use in deciding whether to reject the null hypothesis. Picking a high level of significance for rejecting the null hypothesis means that great emphasis is being placed on avoiding a Type I error (rejecting the null hypothesis, when in fact, the null hypothesis is true). This means that if a 0.10 significance level is chosen, the state wants to keep the chance of making a Type I error at or below ten percent. Hence, if the chosen null hypothesis 2006 IR Guidance

July 2005 41 is “segment meeting WQS,” the state is trying to keep the chance of saying a segment is impaired – when in reality it is not – under ten percent.

An additional policy issue is the Type II errors (not rejecting the null hypothesis, when it should have been). The probability of Type II errors depends on several factors. One key factor is the number of samples available. With a fixed number of samples, as the probability of Type I error decreases, the probability of a Type II error increases. States would ideally collect enough samples so the chances of making Type I and Type II errors are simultaneously small. Unfortunately, resources needed to collect such numbers of samples are quite often not available.

The final example of a policy issue that a state should describe is the rationale for concentrating limited resources to support data collection and statistical analysis in segments where there are documented water quality problems or where the combination of nonpoint source loadings and point source discharges would indicate a strong potential for a water quality problem to exist.

EPA recommends that, when picking the decision rules and statistical methods to be utilized when interpreting data and information, states attempt to minimize the chances of making either of the two following errors:

- Concluding the segment is impaired, when in fact it is not, and*
- Deciding not to declare a segment impaired, when it is in fact impaired.*

States should specify in their methodology what significance level they have chosen to use, in various circumstances. The methodology would best describe in “plain English” the likelihood of deciding to list a segment that in reality is not impaired (Type I error if the null hypothesis is “segment not impaired”). Also, EPA encourages states to estimate, in their assessment databases, the probability of making a Type II error (not putting on the 303(d) list a segment that in fact fails to meet WQS), when: 1) commonly-available numbers of grab samples are available, and 2) the degree of variance in pollutant concentrations are at commonly encountered levels. For example, if an assessment is being performed with a WQC expressed as a 30-day average concentration of a certain pollutant, it would be useful to estimate the probability of a Type II error when the number of available samples over a 30 day period is equal to the average number of samples for that pollutant in segments state-wide, or in a given group of segments, assuming a degree of variance in levels of the pollutant often observed over typical 30 day periods.

Appendix B

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NUMERIC CRITERIA THAT ARE INCLUDED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱ	Notes
Overall use protection (all designated uses)	No data. Evaluated based on similar land use/ geology as stream with water quality data.	Not applicable	Given same rating as monitored stream with same land use and geology.	Data Type Note: This data type is used only for wide-scale assessments of aquatic biota and aquatic habitat for 305(b) Report purposes. This data type is not used in the development of the 303(d) List.
Any designated uses	No data available or where only effluent data is available. Results of dilution calculations or water quality modeling	Not applicable	Where models or other dilution calculations indicate noncompliance with allowable pollutant levels and frequencies noted in this table, waters may be added to Category 3B and considered high priority for water quality monitoring.	
Protection of Aquatic Life	Dissolved oxygen, water temperature, pH, total dissolved gases, oil and grease.	1-4	<u>Full</u> : No more than 10% of all samples exceed criterion. <u>Non-Attainment</u> : Requirements for full attainment not met.	Compliance with Water Quality Standards Note: Some sampling periods are wholly or predominantly during the critical period of the year when criteria violations occur. Where the monitoring program presents good evidence of a demarcation between seasons where criteria exceedences occur and seasons when they do not, the 10% exceedence rate will be based on an annual estimate of the frequency of exceedence. Continuous (e.g. sonde) data with a quality rating of excellent or good will be used for assessments. Chronic pH will be used in the 2018 LMD only if these criteria appear in the Code of State Regulations, and approved by the U.S. Environmental Protection Agency.

Appendix B

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NUMERIC CRITERIA THAT ARE INCLUDED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱ	Notes
Losing Streams	<i>E. coli</i> bacteria	1-4	<p><u>Full</u>: No more than 10% of all samples exceed criterion.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p> <p>The criterion for <i>E. coli</i> is 126 counts/100ml. 10 CSR 20-7.031 (4)(C)</p>	
Protection of Aquatic Life	Toxic chemicals	1-4	<p><u>Full</u>: No more than one acute toxic event in three years that results in a documented die-off of aquatic life such as fish, mussels, and crayfish (does not include die-offs due to natural origin). No more than one exceedence of acute or chronic criterion in the last three years for which data is available.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	<p>Compliance with Water Quality Standards Note: For hardness based metals with eight or fewer samples, the hardness value associated with the sample will be used to calculate the acute or chronic thresholds.</p> <p>For hardness based metals with more than eight samples, the reference percentile hardness provided in state water quality standards will be used to calculate the acute and chronic thresholds.</p>
Protection of Aquatic Life	Nutrients in Lakes (total phosphorus, total nitrogen, plus chlorophyll)	1-4	<p><u>Full</u>: Nutrient levels do not exceed water quality standards following procedures stated in Appendix D.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	<p>Compliance with Water Quality Standards Note: Nutrient criteria will be used in the 2018 LMD only if these criteria appear in the Code of State Regulations, and approved by the U.S. Environmental Protection Agency.</p>
Human Health - Fish Consumption	Chemicals (water)	1-4	<p><u>Full</u>: Water quality does not exceed water quality standards following procedures stated in Appendix D.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	

Appendix B

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NUMERIC CRITERIA THAT ARE INCLUDED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱ	Notes
Drinking Water Supply -Raw Water.	Chemical (toxics)	1-4	<u>Full</u> : Water Quality Standards not exceeded following procedures stated in Appendix D. <u>Non-Attainment</u> : Requirements for full attainment not met.	Designated Use Note: Raw water is water from a stream, lake or groundwater prior to treatment in a drinking water treatment plant.
Drinking Water Supply- Raw Water	Chemical (sulfate, chloride, fluoride)	1-4	<u>Full</u> : Water quality standards not exceeded following procedures stated in Appendix D. <u>Non-Attainment</u> : Requirements for full attainment not met.	
Drinking Water Supply-Finished Water	Chemical (toxics)	1-4	<u>Full</u> : No Maximum Contaminant Level (MCL) violations based on Safe Drinking Water Act data evaluation procedures. <u>Non-Attainment</u> : Requirements for full attainment not met.	Compliance with Water Quality Standards Note: Finished water data will not be used for analytes where water quality problems may be caused by the drinking water treatment process such as the formation of Trihalomethanes (THMs) or problems that may be caused by the distribution system (bacteria, lead, copper).
Whole-Body-Contact Recreation and Secondary Contact Recreation	Fecal coliform or <i>E. coli</i> count	2-4	Where there are at least five samples per year taken during the recreational season: <u>Full</u> : Water quality standards not exceeded as a geometric mean, in any of the last three years for which data is available, for samples collected during seasons for which bacteria criteria apply. <u>Non-Attainment</u> : Requirements for full attainment not met.	Compliance with Water Quality Standards Note: A geometric mean of 206 cfu/100 ml for <i>E. coli</i> will be used as a criterion value for Category B Recreational Waters. Because Missouri's Fecal Coliform Standard ended December 31, 2008, any waters appearing on the 2008 303(d) List as a result of the Fecal Coliform Standard will be retained on the list with the pollutant listed as "bacteria" until sufficient <i>E. coli</i> sampling has determined the status of the water.

Appendix B

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NUMERIC CRITERIA THAT ARE INCLUDED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDSⁱ	Notes
Irrigation, Livestock and Wildlife Water	Chemical	1-4	<u>Full</u> : Water quality standards not exceeded following procedures stated in Appendix D. <u>Non-Attainment</u> : Requirements for full attainment not met.	

ⁱ See section on Statistical Considerations, Appendix C & D.

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱⁱ	Notes
Overall use protection (all beneficial uses)	Narrative criteria for which quantifiable measurements can be made.	1-4	<p><u>Full</u>: Stream condition typical of reference or appropriate control streams in this region of the state.</p> <p><u>Non-Attainment</u>: The weight of evidence, based on the narrative criteria in 10 CSR 20-7.031(3), demonstrates the observed condition exceeds a numeric threshold necessary for the attainment of a beneficial use.</p> <p>For example: Color: Color as measured by the Platinum-Cobalt visual method (SM 2120 B) in a water body is statistically significantly higher than a control water.</p> <p>Objectionable Bottom Deposits: The bottom that is covered by sewage sludge, trash, or other materials reaching the water due to anthropogenic sources exceeds the amount in reference or control streams by more than 20 percent.</p> <p>Note: Waters in mixing zones and unclassified waters that support aquatic life on an intermittent basis shall be subject to acute toxicity criteria for protection of aquatic life. Waters in the initial Zone of Dilution shall not be subject to acute toxicity criteria.</p>	

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱⁱ	Notes
Protection of Aquatic Life	Toxic Chemicals	1-4	<p><u>Full</u>: No more than one acute toxic event in three years (does not include die-offs of aquatic life due to natural origin). No more than one exceedence of acute or chronic criterion in three years for all toxics.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	<p>Compliance with Water Quality Standards Note: The test result must be representative of water quality for the entire time period for which acute or chronic criteria apply. For ammonia the chronic exposure period is 30 days, for all other toxics 96 hours. The acute exposure period for all toxics is 24 hours, except for ammonia which has a one hour exposure period. The department will review all appropriate data, including hydrographic data, to ensure only representative data are used. Except on large rivers where storm water flows may persist at relatively unvarying levels for several days, grab samples collected during storm water flows will not be used for assessing chronic toxicity criteria.</p> <p>Compliance with Water Quality Standards Note: In the case of toxic chemicals occurring in benthic sediment rather than in water, the numeric thresholds used to determine the need for further evaluation will be the Probable Effect Concentrations proposed in “Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems” by MacDonald, D.D. <i>et al.</i> Arch. Environ. Contam. Toxicol. 39,20-31 (2000). These Probable Effect Concentrations are as follows: 33 mg/kg As; 4.98 mg/kg Cd; 111 mg/kg Cr; 149 mg/kg Cu; 48.6 mg/kg Ni; 128 mg/kg Pb; 459 mg/kg Zn; 561 µg/kg naphthalene; 1170 µg/kg phenanthrene; 1520 µg/kg pyrene; 1050 µg/kg benzo(a)anthracene; 1290 µg/kg chrysene; 1450 µg/kg benzo(a)pyrene; 22,800 µg/kg total polyaromatic hydrocarbons; 676 µg/kg total PCBs; chlordane 17.6 ug/kg; Sum DDE 31.3 ug/kg; lindane (gamma-BHC) 4.99 ug/kg. Where multiple sediment contaminants exist, the Probable Effect Concentrations Quotient shall not exceed 0.75. See Appendix D and Section II. D for more information on the Probable Effect Concentrations Quotient.</p>

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱⁱ	Notes
Protection of Aquatic Life	Biological: Aquatic Macro- invertebrates sampled using DNR Protocol.	3-4	<p><u>Full:</u> For seven or fewer samples and following DNR wadeable streams macroinvertebrate sampling and evaluation protocols, 75% of the stream condition index scores must be 16 or greater. Fauna achieving these scores are considered to be very similar to regional reference streams. For greater than seven samples or for other sampling and evaluation protocols, results must be statistically similar to representative reference or control stream.</p> <p><u>Non-Attainment:</u> For seven or fewer samples and following DNR wadeable streams macroinvertebrate sampling and evaluation protocols, 75% of the stream condition index scores must be 14 or lower. Fauna achieving these scores are considered to be substantially different from regional reference streams. For more than seven samples or for other sampling and evaluation protocols, results must be statistically dissimilar to control or representative reference streams.</p>	<p>Data Type Note: DNR invert protocol will not be used for assessment in the Mississippi Alluvial Basin (bootheel area) due to lack of reference streams for comparison.</p> <p>Data Type Note: See Section II.D. for additional criteria used to assess biological data.</p> <p>Compliance with Water Quality Standards Note: See Appendix D. For test streams that are smaller than bioreference streams (Table I of Water Quality Standards) where both bioreference streams and small control streams are used to assess the biological integrity of the test stream, the assessment of the data should display and take into account both types of control streams.</p>
Protection of Aquatic Life	Biological: MDC Fish Community (RAM) Protocol (Ozark Plateau only)	3-4	<p><u>Full:</u> For seven or fewer samples and following MDC RAM fish community protocols, 75% of the fIBI scores must be 36 or greater. Fauna achieving these scores are considered to be very similar to regional reference streams. For greater than seven samples or for other sampling</p>	<p>Data Type Note: See Section II.D. for additional criteria used to assess biological data.</p> <p>Compliance with Water Quality Standards Note: MDC fIBI scores are from “Biological Criteria for Streams and Fish Communities in Missouri” by Doisy et al. (2008). If habitat limitations (as measured by either the QCPH1 index or other appropriate methods) are judged to contribute to low fish</p>

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱⁱ	Notes
			<p>and evaluation protocols, results must be statistically similar to representative reference or control streams.</p> <p><u>Suspected of Impairment:</u> Data not conclusive (Category 2B or 3B). For first and second order streams fIBI score < 29.</p> <p><u>Non-Attainment:</u> First and second order streams will not be assessed for non-attainment. When assessing third to fifth order streams with data sets of seven or fewer samples collected by following MDC RAM fish community protocols, 75% of the fIBI scores must be lower than 36. Fauna achieving these scores are considered to be substantially different from regional reference streams. For more than seven samples or for other sampling and evaluation protocols, results must be statistically dissimilar to control or representative reference streams.</p>	<p>community scores and this is the only type of data available, the water body will be included in Category 4C, 2B, or 3B. If other types of data exist, the weight of evidence approach will be used as described in this document.</p> <p>Compliance with Water Quality Standards Note: For determining influence of poor habitat on those samples that are deemed as impaired, consultation with MDC RAM staff will be utilized. If, through this consultation, habitat is determined to be a significant possible cause for impairment, the water body will not be rated as impaired, but rather as suspect of impairment (categories 2B or 3B).</p> <p>Compliance with Water Quality Standards Note: See Appendix D. For test streams that are significantly smaller than bioreference streams where both bioreference streams and small candidate reference streams are used to assess the biological integrity of the test stream, the assessment of the data should display and take into account both biocriteria reference streams and candidate reference streams.</p>
Protection of Aquatic Life	Other Biological Data	3-4	<p><u>Full:</u> Results must be statistically similar to representative reference or control streams.</p> <p><u>Non-Attainment:</u> Results must be statistically dissimilar to control or representative reference streams.</p>	Data Type Note: See Section II.D. for additional criteria used to assess biological data

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱⁱ	Notes
Protection of Aquatic Life	Toxicity testing of streams or lakes using aquatic organisms	2	<p><u>Full</u>: No more than one test result of statistically significant deviation from controls in acute or chronic test in a three-year period.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	
Human Health - Fish Consumption	Chemicals (tissue)	1-2	<p><u>Full</u>: Contaminant levels in fish tissue levels in fillets, tissue plugs, and eggs do not exceed guidelines.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	<p>Compliance with Water Quality Standards Note: Fish tissue threshold levels are; chlordane 0.1 mg/kg (Crellin, J.R. 1989, <i>“New Trigger Levels for Chlordane in Fish-Revised Memo”</i> Mo. Dept. of Health inter-office memorandum. June 16, 1989); mercury 0.3 mg/kg based on “Water Quality Criterion for Protection of Human Health: Methylmercury” EPA-823-R-01-001. Jan. 2001.</p> <p>http://www.epa.gov/waterscience/criteria/methylmercury/merctitl.pdf; PCBs 0.75 mg/kg, MDHSS Memorandum August 30, 2006 <i>“Development of PCB Risk-based Fish Consumption Limit Tables;”</i> and lead 0.3- mg/kg (World Health Organization 1972. <i>“Evaluation of Certain Food Additives and the Contaminants Mercury, Lead and Cadmium.”</i> WHO Technical Report Series No. 505, Sixteenth Report on the Joint FAO/WHO Expert Committee on Food Additives. Geneva 33 pp. Assessment of Mercury will be based on samples solely from the following higher trophic level fish species: Walleye, Sauger, Trout, Black Bass, White Bass, Striped Bass, Northern Pike, Flathead Catfish and Blue Catfish. In a 2012 DHSS memorandum (not yet approved, but are being considered for future LMD revisions) threshold values are proposed to change as follows: chlordane 0.2 mg/kg ; mercury 0.27 mg/kg ; and PCBs = 0.540 ; lead has not changed, but they do add atrazine and PDBEs (Fish Fillet Advisory Concentrations (FFACs) in Missouri).</p>

ⁱⁱ See section on Statistical Considerations and Appendix D.

Appendix D
DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11” X 14” FOLD OUT)

			Determining when waters are impaired			Determining when waters are no longer impaired			Notes
Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Narrative Criteria	Color	Hypothesis Test: Two Sample, one tailed t-Test	Null Hypothesis: There is no difference in color between test stream and control stream.	Reject Null Hypothesis if calculated “t” value exceeds tabular “t” value for test alpha	0.1	Same Hypothesis	Same Criterion	0.4	
	Bottom deposits	Hypothesis Test, Two Sample, one tailed “t” Test	Null Hypothesis: Solids of anthropogenic origin cover less than 20% of stream bottom where velocity is less than 0.5 feet/second.	Reject Null Hypothesis if 60% Lower Confidence Limit (LCL) of mean percent fine sediment deposition (pfsd) in stream is greater than the sum of the pfsd in the control and 20 % more of the stream bottom. i.e., where the pfsd is expressed as a decimal, test stream pfsd > (control stream pfsd)+(0.20)	0.4	Same Hypothesis	Same Criterion	Same Significance Level	Criterion Note: If data is non-normal a nonparametric test will be used as a comparison of medians. The same 20% difference still applies. With current software the Mann- Whitney test is used.

Appendix D
DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

			Determining when waters are impaired			Determining when waters are no longer impaired			Notes
Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Aquatic Life	Biological monitoring (Narrative)	For DNR Invert protocol: Sample sizes of 7 or less, 75% of samples must score 14 or lower.	Using DNR Invert. Protocol: Null Hypothesis: Frequency of full sustaining scores for test stream is the same as for biological criteria reference streams.	Reject Null Hypothesis if frequency of fully sustaining scores on test stream is significantly less than for biological criteria reference streams.	Not Applicable	Same Hypothesis	Same Criterion	Same Significance Level	
		For RAM Fish IBI protocol: Sample sizes of 7 or less, 75% of samples must score less than 36.							
		For DNR Invert protocol and sample size of 8 or more: Binomial Probability	A direct comparison of frequencies between test and biological criteria reference streams will be made.	Rate as impaired if biological criteria reference stream frequency of fully biologically supporting scores is greater than five percent more than test stream.	0.1	Same Hypothesis	Same Criterion	0.4	Criterion Note: For inverts, the reference number will change depending on which EDU the stream is in (X%-5%), for RAM samples the reference number will always be 70 (75%-5%).
		For RAM Fish IBI protocol and sample size of 8 or more: Binomial Probability.							
		For other biological data an appropriate parametric or	Null Hypothesis, Community metric(s) in	Reject Null Hypothesis if metric scores for test stream are	0.1	Same Hypothesis	Same Criterion	0.4	

Appendix D
DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11” X 14” FOLD OUT)

			Determining when waters are impaired			Determining when waters are no longer impaired			Notes
Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Aquatic Life (cont.)		nonparametric test will be used.	test stream is the same as for a reference stream or control streams.	significantly less than reference or control streams.					
			Other biological monitoring to be determined by type of data.	Dependent upon available information.	Dependent upon available information.	Same Hypothesis	Same Criterion	Same Significance Level	
	Toxic chemicals in water: (Numeric)	Not applicable	No more than one toxic event, toxicity test failure or exceedence of acute or chronic criterion in 3 years.	Not applicable	Not applicable	Same Hypothesis	Same Criterion	Same Significance Level	
	Toxic chemicals in sediments: (Narrative)	Comparison of geometric mean to PEC value, or calculation of a PECQ value.	Waters are judged to be impaired if parameter geomean exceeds PEC, or site PECQ is exceeded.	For metals use 150% PEC threshold. The PECQ threshold value is 0.75.	Not applicable	Water is judged to be unimpaired if parameter geomean is equal to or less than PEC, or site PECQ equaled or not exceeded.	For metals use 150% of PEC threshold. The PECQ threshold value is 0.75.	Not applicable	Compliance with Water Quality Standards Note: In the case of toxic chemicals occurring in benthic sediment rather than in water, the numeric thresholds used to determine the need for further evaluation will be the Probable Effect Concentrations proposed in “Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems” by MacDonald, D.D. <i>et al.</i> Arch. Environ. Contam. Toxicol. 39,20-31 (2000). These Probable Effect Concentrations are as follows:

Appendix D
DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

			Determining when waters are impaired			Determining when waters are no longer impaired			Notes
Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Aquatic Life (cont.)									33 mg/kg As; 4.98 mg/kg Cd; 111 mg/kg Cr; 149 mg/kg Cu; 48.6 mg/kg Ni; 128 mg/kg Pb; 459 mg/kg Zn; 561 µg/kg naphthalene; 1170 µg/kg phenanthrene; 1520 µg/kg pyrene; 1050 µg/kg benzo(a)anthracene, 1290 µg/kg chrysene; 1450 µg/kg benzo(a)pyrene; 22,800 µg/kg total polyaromatic hydrocarbons; 676 µg/kg total PCBs; chlordan 17.6 ug/kg; Sum DDE 31.3 ug/kg; lindane (gamma-BHC) 4.99 ug/kg. Where multiple sediment contaminants exist, the Probable Effect Concentrations Quotient shall not exceed 0.75. See Appendix D and Section II. D for more information on the Probable Effect Concentrations Quotient.
	Temperatu re, pH, total diss. gases, oil and grease, diss. oxygen (Numeric)	Binomial probability	Null Hypothesis: No more than 10% of samples exceed the water quality criterion.	Reject Null Hypothesis if the Type I error rate is less than 0.1.	Not applicable	Same Hypothesis	Same Criterion	Same Significance Level	
Losing Streams	<i>E.coli</i>	Binomial probability	Null Hypothesis: No more than 10% of samples exceed the water quality criterion.	Reject Null Hypothesis if the Type I error rate is less than 0.1.	0.1	Same Hypothesis	Same Criterion	Same Significance Level	

Appendix D
DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

			Determining when waters are impaired			Determining when waters are no longer impaired			Notes
Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Human Health – Fish Consumption	Toxic chemicals in water (Numeric)	Hypothesis test: 1-sided confidence limit	Null Hypothesis: Levels of contaminants in water do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject Null Hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
	Toxic chemicals in tissue (Narrative)	Four or more samples: Hypothesis test 1-sided confidence limit	Null Hypothesis: Levels in fillet samples or fish eggs do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
Drinking Water Supply (Raw)	Toxic chemicals (Numeric)	Hypothesis test: 1-sided confidence limit	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
	Non-toxic chemicals (Numeric)	Hypothesis test: 1-sided confidence limit	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis: if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
Drinking Water Supply (Finished)	Toxic chemicals	Methods stipulated by Safe Drinking Water Act.	Methods stipulated by Safe Drinking Water Act.	Methods stipulated by Safe Drinking Water Act.	Methods stipulated by Safe Drinking Water Act.	Same Hypothesis	Same Criterion	Same Significance Level	

Appendix D
DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

Designated Use	Analytes	Analytical Tool	Determining when waters are impaired			Determining when waters are no longer impaired			Notes
			Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Whole Body Contact and Secondary	Bacteria (Numeric)	Geometric mean	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis: if the geometric mean is greater than the criterion value.	Not Applicable	Same Hypothesis	Same Criterion	Not applicable	
Irrigation & Livestock Water	Toxic chemicals (Numeric)	Hypothesis test 1-Sided confidence limit	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
Protection of Aquatic Life	Nutrients in lakes (Numeric)	Hypothesis test	Null hypothesis: Criteria are not exceeded.	Reject Null Hypothesis if 60% LCL value is greater than criterion value.	0.4	Same Hypothesis	Same Criterion	Same Significance Level	Hypothesis Test Note: State nutrient criteria require at least four samples per year taken near the outflow point of the lake (or reservoir) between May 1 and August 31 for at least four different, not necessarily consecutive, years.

ⁱⁱⁱ Where hypothesis testing is used for media other than fish tissue, for data sets with five samples or fewer, a 75 percent confidence interval around the appropriate central tendencies will be used to determine use attainment status. Use attainment will be determined as follows: (1) If the criterion value is above this interval (all values within the interval are in conformance with the criterion), rate as unimpaired; (2) If the criterion value falls within this interval, rate as unimpaired and place in Category 2B or 3B; (3) If the criterion value is below this interval (all values within the interval are not in conformance with the criterion), rate as impaired. For fish tissue, this procedure will be used with the following changes: (1) it will apply only to sample sizes of less than four and, (2) a 50% confidence interval will be used in place of the 75% confidence interval.



Missouri Department of Natural Resources
2018 Section 303(d) Listed Waters

Clean Water Commission Approved 10-18-2018

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
1	2012	2188.00	Antire Cr.	P	1.90	Yes	1.90	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140102	1
2	2018	2668.00	Ashley Cr.	P	2.50	Yes	2.50	Miles	WBC B	Escherichia coli (W)	Source Unknown	Dent	11010008	1
3	2010	7627.00	August A Busch Lake No. 37	UL	30.00	Yes	30.00	Acres	GEN	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Charles	07110009	1, 7
4	2018	7637.00	August A Busch Lake Number 36	UL	16.00	Yes	16.00	Acres	GEN	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Charles	07110009	1, 7
5	2016	4083.00	Barker Creek tributary	C	1.20	Yes	1.20	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Henry	10290108	1
6	2018	2693.00	Barn Hollow	C	8.20	Yes	8.20	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Howell/Texas	11010008	1
7	2012	0752.00	Bass Cr.	C	4.40	Yes	4.40	Miles	WBC A	Escherichia coli (W)	Rural NPS	Boone	10300102	1
8	2012	3240.00	Baynham Br.	P	4.00	Yes	4.00	Miles	WBC B	Escherichia coli (W)	Rural NPS	Newton	11070207	1
9	2014	3224.00	Beef Br.	P	2.50	Yes	2.50	Miles	AQL	Cadmium (S)	Mill Tailings	Newton	11070207	1
10	2014	3224.00	Beef Br.	P	2.50	Yes	2.50	Miles	AQL	Cadmium (W)	Mill Tailings	Newton	11070207	1
11	2014	3224.00	Beef Br.	P	2.50	Yes	2.50	Miles	AQL	Lead (S)	Mill Tailings	Newton	11070207	1
12	2014	3224.00	Beef Br.	P	2.50	Yes	2.50	Miles	AQL	Zinc (S)	Mill Tailings	Newton	11070207	1
13	2014	3224.00	Beef Br.	P	2.50	Yes	2.50	Miles	AQL	Zinc (W)	Mill Tailings	Newton	11070207	1
14	2006	2760.00	Bee Fk.	C	8.70	No	8.70	Miles	AQL	Lead (W)	Fletcher Lead Mine/Mill	Reynolds	11010007	1
15	2014	7309.00	Bee Tree Lake	L3	10.00	Yes	10.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Louis	07140102	1
16	2006	7365.00	Belcher Branch Lake	L3	42.00	Yes	42.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Buchanan	10240012	1
17	2018	7186.00	Ben Branch Lake	L3	37.00	No	37.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Osage	10300102	1
18	2014	3980.00	Bens Branch	C	5.80	Yes	5.80	Miles	AQL	Cadmium (S)	Oronogo/Duenweg Mining Belt	Jasper	11070207	1
19	2018	3980.00	Bens Branch	C	5.80	Yes	5.80	Miles	AQL	Cadmium (W)	Mill Tailings	Jasper	11070207	1
20	2014	3980.00	Bens Branch	C	5.80	Yes	5.80	Miles	AQL	Lead (S)	Oronogo/Duenweg Mining Belt	Jasper	11070207	1
21	2014	3980.00	Bens Branch	C	5.80	Yes	5.80	Miles	AQL	Zinc (S)	Oronogo/Duenweg Mining Belt	Jasper	11070207	1
22	2016	3980.00	Bens Branch	C	5.80	Yes	5.80	Miles	AQL	Zinc (W)	Oronogo/Duenweg Mining Belt	Jasper	11070207	1
23	2010	2916.00	Big Cr.	P	34.10	No	34.10	Miles	AQL	Cadmium (S)	Glover smelter	Iron	08020202	1
24	2010	1578.00	Big Piney R.	P	7.80	No	7.80	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Texas	10290202	1, 5
25	2006	2080.00	Big R.	P	81.30	No	81.30	Miles	AQL	Cadmium (S)	Old Lead Belt tailings	St. Francois/Jefferson	07140104	1
26	2012	2080.00	Big R.	P	81.30	Yes	81.30	Miles	AQL	Zinc (S)	Old Lead Belt tailings	St. Francois/Jefferson	07140104	1
27	2006	3184.00	Blackberry Cr.	C	6.50	No	6.50	Miles	AQL	Chloride (W)	Asbury Power Plant	Jasper	11070207	1
28	2016	3184.00	Blackberry Cr.	C	6.50	Yes	6.50	Miles	AQL	Oxygen, Dissolved (W)	Ind. Point Source Discharge and NPS	Jasper	11070207	1
29	2008	3184.00	Blackberry Cr.	C	6.50	No	6.50	Miles	AQL	Sulfate + Chloride (W)	Asbury Power Plant	Jasper	11070207	1
30	2012	0111.00	Black Cr.	P	19.40	Yes	19.40	Miles	WBC B	Escherichia coli (W)	Shelbyville WWTF, Nonpoint Source	Shelby	07110005	1
31	2006	3825.00	Black Cr.	P	1.60	Yes	1.60	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
32	2012	3825.00	Black Cr.	P	1.60	Yes	1.60	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
33	2012	3825.00	Black Cr.	P	1.60	Yes	1.60	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
34	2002	2769.00	Black R.	P	47.10	Yes	47.10	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Butler	11010007	1, 5
35	2002	2784.00	Black R.	P	39.00	Yes	39.00	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Wayne/Butler	11010007	1, 5
36	2006	0417.00	Blue R.	P	4.40	Yes	4.40	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
37	2016	0417.00	Blue R.	P	4.40	Yes	4.40	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
38	2006	0418.00	Blue R.	P	9.40	Yes	9.40	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
39	2016	0418.00	Blue R.	P	9.40	Yes	9.40	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
40	2006	0419.00	Blue R.	P	7.70	Yes	7.70	Miles	WBC A	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
41	2012	1701.00	Bonhomme Cr.	C	2.50	Yes	2.50	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	10300200	1
42	2006	0750.00	Bonne Femme Cr.	P	7.80	Yes	7.80	Miles	WBC A	Escherichia coli (W)	Rural NPS	Boone	10300102	1
43	2012	0753.00	Bonne Femme Cr.	C	7.00	Yes	7.00	Miles	WBC B	Escherichia coli (W)	Rural NPS	Boone	10300102	1
44	2002	2034.00	Bourbeuse R.	P	136.70	Yes	136.70	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Phelps/Franklin	07140103	1, 5
45	2014	7003.00	Bowling Green Lake - Old	L1	7.00	Yes	7.00	Acres	AQL	Chlorophyll-a (W)	Rural NPS	Pike	07110004	1, 4, 5
46	2012	7003.00	Bowling Green Lake - Old	L1	7.00	Yes	7.00	Acres	AQL	Nitrogen, Total (W)	Rural NPS	Pike	07110004	1, 4, 5
47	2012	7003.00	Bowling Green Lake - Old	L1	7.00	Yes	7.00	Acres	AQL	Phosphorus, Total (W)	Rural NPS	Pike	07110004	1, 4, 5
48	2012	1796.00	Brazeau Cr.	P	10.80	Yes	10.80	Miles	WBC B	Escherichia coli (W)	Rural NPS	Perry	07140105	1
49	2002	1371.00	Brush Cr.	P	4.70	Yes	4.70	Miles	AQL	Oxygen, Dissolved (W)	Humansville WWTP	Polk/St. Clair	10290106	1
50	2016	3986.00	Brush Creek	C	5.40	Yes	5.40	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
51	2016	3986.00	Brush Creek	C	5.40	Yes	5.40	Miles	AQL	Oxygen, Dissolved (W)	Nonpoint Source	Jackson	10300101	1
52	2014	3986.00	Brush Creek	C	5.40	Yes	5.40	Miles	AQL	Polycyclic Aromatic Hydrocarbons-PAHs (S)	Nonpoint Source	Jackson	10300101	1
53	2016	7117.00	Buffalo Bill Lake	L3	45.00	Yes	45.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	DeKalb	10280101	1
54	2012	3273.00	Buffalo Cr.	P	8.00	Yes	8.00	Miles	AQL	Fishes Bioassessments/ Unknown (W)	Source Unknown	Newton/McDonald	11070208	1, 8
55	2006	1865.00	Burgher Br.	C	1.50	Yes	1.50	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Phelps	07140102	1
56	2018	3414.00	Burr Oak Cr.	C	6.80	Yes	6.80	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
57	2018	3414.00	Burr Oak Cr.	C	6.80	Yes	6.80	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
58	2006	7057.00	Busch W.A. No. 35 Lake	L3	51.00	Yes	51.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Charles	07110009	1
59	2006	3234.00	Capps Cr.	P	5.00	Yes	5.00	Miles	WBC A	Escherichia coli (W)	Rural NPS	Barry/Newton	11070207	1
60	2016	3241.00	Carver Br.	P	3.00	Yes	3.00	Miles	WBC A	Escherichia coli (W)	Nonpoint Source	Newton	11070207	1
61	2010	2288.00	Castor R.	P	7.50	Yes	7.50	Miles	WBC A	Escherichia coli (W)	Rural NPS	Bollinger	07140107	2
62	2008	0737.00	Cedar Cr.	C	37.40	No	37.40	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Boone	10300102	1, 8
63	2008	1344.00	Cedar Cr.	P	31.00	No	31.00	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Cedar	10290106	1, 8

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
64	2016	1344.00	Cedar Cr.	P	31.00	Yes	31.00	Miles	WBC A	Escherichia coli (W)	Rural NPS	Cedar	10290106	1
65	2010	1344.00	Cedar Cr.	P	31.00	No	31.00	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Cedar	10290106	1
66	2010	1357.00	Cedar Cr.	C	16.20	Yes	16.20	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Dade/Cedar	10290106	1, 8
67	2008	1357.00	Cedar Cr.	C	16.20	Yes	16.20	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Dade/Cedar	10290106	1
68	2006	3203.00	Center Cr.	P	26.80	No	26.80	Miles	AQL	Cadmium (S)	Tri-State Mining District	Jasper	11070207	1
69	2006	3203.00	Center Cr.	P	26.80	No	26.80	Miles	AQL	Cadmium (W)	Tri-State Mining District	Jasper	11070207	1
70	2014	3203.00	Center Cr.	P	26.80	Yes	26.80	Miles	WBC A	Escherichia coli (W)	Nonpoint Source	Jasper	11070207	1
71	2006	3203.00	Center Cr.	P	26.80	No	26.80	Miles	AQL	Lead (S)	Tri-State Mining District	Jasper	11070207	1
72	2008	3210.00	Center Cr.	P	21.00	Yes	21.00	Miles	WBC A	Escherichia coli (W)	Rural NPS	Newton/Jasper	11070207	1
73	2010	3214.00	Center Cr.	P	4.90	Yes	4.90	Miles	WBC A	Escherichia coli (W)	Rural NPS	Lawrence/Newton	11070207	1
74	2016	5003.00	Center Creek tributary	C	2.70	Yes	2.70	Miles	AQL	Cadmium (W)	Oronogo/Duenweg Mining Belt	Jasper	11070207	1
75	2016	5003.00	Center Creek tributary	C	2.70	Yes	2.70	Miles	AQL	Zinc (W)	Oronogo/Duenweg Mining Belt	Jasper	11070207	1
76	2006	3168.00	Chat Cr.	C	2.10	Yes	2.10	Miles	AQL	Cadmium (W)	Baldwin Park Mine	Lawrence	11070207	1
77	2012	3963.00	Chat Creek tributary	US	0.90	Yes	0.90	Miles	GEN	Cadmium (W)	Baldwin Park Mine	Lawrence	11070207	1, 7
78	2012	3963.00	Chat Creek tributary	US	0.90	Yes	0.90	Miles	GEN	Zinc (W)	Baldwin Park Mine	Lawrence	11070207	1, 7
79	2014	7634.00	Chaudiere Lake	UL	3.40	Yes	3.40	Acres	GEN	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Clay	10300101	1, 7
80	2012	1781.00	Cinque Hommes Cr.	P	17.10	Yes	17.10	Miles	WBC B	Escherichia coli (W)	Rural NPS	Perry	07140105	1
81	2016	1781.00	Cinque Hommes Cr.	P	17.10	Yes	17.10	Miles	SCR	Escherichia coli (W)	Rural NPS	Perry	07140105	1
82	2018	1000.00	Clark Fk.	C	6.00	Yes	6.00	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Cole	10300102	1
83	2006	1333.00	Clear Cr.	P	28.20	Yes	28.20	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Vernon/St. Clair	10290105	1
84	2006	1336.00	Clear Cr.	C	22.30	Yes	22.30	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Vernon	10290105	1
85	2006	3238.00	Clear Cr.	P	11.10	Yes	11.10	Miles	WBC B	Escherichia coli (W)	Rural NPS	Lawrence/Newton	11070207	1
86	2002	3239.00	Clear Cr.	C	3.50	Yes	3.50	Miles	AQL	Nutrient/Eutrophication Biol. Indicators (W)	Monett WWTP	Barry/Lawrence	11070207	1, 4
87	2002	3239.00	Clear Cr.	C	3.50	Yes	3.50	Miles	AQL	Oxygen, Dissolved (W)	Monett WWTP	Barry/Lawrence	11070207	1
88	2006	0935.00	Clear Fk.	P	25.80	No	25.80	Miles	AQL	Oxygen, Dissolved (W)	Knob Noster WWTP	Johnson	10300104	1
89	2014	7326.00	Clearwater Lake	L2	1635.00	Yes	1635.00	Acres	AQL	Chlorophyll-a (W)	Rural NPS	Wayne/Reynolds	11010007	1, 4
90	2002	7326.00	Clearwater Lake	L2	1635.00	Yes	1635.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Wayne/Reynolds	11010007	1
91	2016	7326.00	Clearwater Lake	L2	1635.00	Yes	1635.00	Acres	AQL	Phosphorus, Total (W)	Nonpoint Source	Wayne/Reynolds	11010007	1, 4
92	2006	1706.00	Coldwater Cr.	C	6.90	Yes	6.90	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	10300200	1
93	2012	2177.00	Coonville Cr.	C	1.30	Yes	1.30	Miles	AQL	Lead (W)	Source Unknown	St. Francois	07140104	1
94	2016	7378.00	Coot Lake	L3	20.00	Yes	20.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	10290108	1
95	2016	7379.00	Cottontail Lake	L3	22.00	Yes	22.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	10290108	1
96	2006	1943.00	Courtois Cr.	P	32.00	No	32.00	Miles	AQL	Lead (S)	Doe Run Viburnum Division Lead mine	Washington	07140102	1
97	2012	2382.00	Crane Cr.	P	13.20	Yes	13.20	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Stone	11010002	1, 8
98	2016	7334.00	Crane Lake	L3	109.00	Yes	109.00	Acres	AQL	Chlorophyll-a (W)	Source Unknown	Iron	08020202	1, 4
99	2016	7334.00	Crane Lake	L3	109.00	Yes	109.00	Acres	AQL	Phosphorus, Total (W)	Source Unknown	Iron	08020202	1, 4

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
100	2012	2816.00	Craven Ditch	C	11.60	Yes	11.60	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Butler	11010007	1
101	2006	1703.00	Creve Coeur Cr.	C	3.80	Yes	3.80	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	10300200	1
102	2006	1928.00	Crooked Cr.	P	3.50	Yes	3.50	Miles	AQL	Cadmium (S)	Buick Lead Smelter	Crawford	07140102	1
103	2006	1928.00	Crooked Cr.	P	3.50	Yes	3.50	Miles	AQL	Cadmium (W)	Buick Lead Smelter	Crawford	07140102	1
104	2006	1928.00	Crooked Cr.	P	3.50	Yes	3.50	Miles	AQL	Lead (S)	Buick Lead Smelter	Crawford	07140102	1
105	2008	3961.00	Crooked Creek	C	6.50	Yes	6.50	Miles	AQL	Cadmium (W)	Buick Lead Smelter	Iron/Crawford	07140102	1
106	2010	3961.00	Crooked Creek	C	6.50	Yes	6.50	Miles	AQL	Copper (W)	Buick Lead Smelter	Iron/Crawford	07140102	1
107	2016	7135.00	Crowder St. Park Lake	L3	18.00	Yes	18.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Grundy	10280102	1
108	2006	2636.00	Current R.	P	124.00	Yes	124.00	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Shannon/Ripley	11010008	1
109	2018	2662.00	Current R.	P	18.80	Yes	18.80	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Dent/Shannon	11010008	1
110	2006	0219.00	Dardenne Cr.	P1	7.00	Yes	7.00	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	St. Charles	07110009	1
111	2018	0221.00	Dardenne Cr.	P	16.50	Yes	16.50	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Charles	07110009	1
112	2006	3826.00	Deer Cr.	P	1.60	Yes	1.60	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	07140101	1
113	2012	3826.00	Deer Cr.	P	1.60	Yes	1.60	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	07140101	1
114	2012	3826.00	Deer Cr.	P	1.60	Yes	1.60	Miles	WBC A	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	07140101	1
115	2002	7015.00	Deer Ridge Community Lake	L3	39.00	Yes	39.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Lewis	07110002	1
116	2006	3109.00	Ditch #36	P	7.80	Yes	7.80	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Dunklin	08020204	1
117	2006	3810.00	Douger Br.	C	2.80	Yes	2.80	Miles	AQL	Lead (S)	Aurora Lead Mining District	Lawrence	11070207	1
118	2006	3810.00	Douger Br.	C	2.80	Yes	2.80	Miles	AQL	Zinc (S)	Aurora Lead Mining District	Lawrence	11070207	1
119	2006	1180.00	Dousinbury Cr.	P	3.90	Yes	3.90	Miles	WBC B	Escherichia coli (W)	Rural NPS	Dallas	10290110	1
120	2016	1792.00	Dry Fk.	C	3.20	Yes	3.20	Miles	WBC B	Escherichia coli (W)	Source Unknown	Perry	07140105	1
121	2008	3189.00	Dry Fk.	C	10.20	Yes	10.20	Miles	WBC A	Escherichia coli (W)	Rural NPS	Jasper	11070207	1
122	2016	3163.00	Dry Hollow	C	0.50	Yes	0.50	Miles	SCR	Escherichia coli (W)	Source Unknown	Lawrence	11070207	1
123	2006	3569.00	Dutro Carter Cr.	P	1.50	No	1.50	Miles	AQL	Oxygen, Dissolved (W)	Rolla SE WWTP	Phelps	07140102	1
124	2016	3570.00	Dutro Carter Cr.	C	0.50	Yes	0.50	Miles	SCR	Escherichia coli (W)	Source Unknown	Phelps	07140102	1
125	2016	3570.00	Dutro Carter Cr.	C	0.50	Yes	0.50	Miles	WBC B	Escherichia coli (W)	Source Unknown	Phelps	07140102	1
126	2016	3199.00	Duval Cr.	C	7.00	Yes	7.00	Miles	WBC B	Escherichia coli (W)	Nonpoint Source	Jasper	11070207	1
127	2006	2166.00	Eaton Br.	C	1.20	Yes	1.20	Miles	AQL	Cadmium (S)	Leadwood tailings pond	St. Francois	07140104	1
128	2006	2166.00	Eaton Br.	C	1.20	Yes	1.20	Miles	AQL	Cadmium (W)	Leadwood tailings pond	St. Francois	07140104	1
129	2006	2166.00	Eaton Br.	C	1.20	Yes	1.20	Miles	AQL	Lead (S)	Leadwood tailings pond	St. Francois	07140104	1
130	2018	2166.00	Eaton Br.	C	1.20	Yes	1.20	Miles	AQL	Lead (W)	Leadwood tailings pond	St. Francois	07140104	1
131	2006	2166.00	Eaton Br.	C	1.20	Yes	1.20	Miles	AQL	Zinc (S)	Leadwood tailings pond	St. Francois	07140104	1
132	2006	2166.00	Eaton Br.	C	1.20	Yes	1.20	Miles	AQL	Zinc (W)	Leadwood tailings pond	St. Francois	07140104	1
133	2010	0372.00	E. Fk. Crooked R.	P	19.90	Yes	19.90	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Rav	10300101	1

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
134	2006	0457.00	E. Fk. Grand R.	P	28.70	Yes	28.70	Miles	WBC A	Escherichia coli (W)	Rural NPS	Worth/Gentry	10280101	1, 5
135	2018	0428.00	E. Fk. L. Blue R.	C	3.70	Yes	3.70	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
136	2008	0608.00	E. Fk. Locust Cr.	P	16.70	Yes	16.70	Miles	WBC B	Escherichia coli (W)	Nonpoint Source	Sullivan	10280103	1
137	2018	0608.00	E. Fk. Locust Cr.	P	16.70	Yes	16.70	Miles	SCR	Escherichia coli (W)	Nonpoint Source	Sullivan	10280103	1
138	2008	0610.00	E. Fk. Locust Cr.	C	15.70	Yes	15.70	Miles	WBC A	Escherichia coli (W)	Rural NPS	Sullivan	10280103	1
139	2008	0610.00	E. Fk. Locust Cr.	C	15.70	No	15.70	Miles	AQL	Oxygen, Dissolved (W)	Rural NPS	Sullivan	10280103	1
140	2018	1282.00	E. Fk. Tebo Cr.	C	14.50	Yes	14.50	Miles	AQL	Ammonia, Total (W)	Municipal Point Source Discharges	Henry	10290108	1
141	2006	1282.00	E. Fk. Tebo Cr.	C	14.50	No	14.50	Miles	AQL	Oxygen, Dissolved (W)	Windsor SW WWTP	Henry	10290108	1
142	2002	2593.00	Eleven Point R.	P	22.70	Yes	22.70	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Oregon	11010011	1
143	2006	2597.00	Eleven Point R.	P	11.40	Yes	11.40	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Oregon	11010011	1
144	2008	2601.00	Eleven Point R.	P	22.30	Yes	22.30	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Oregon	11010011	1
145	2002	0189.00	Elkhorn Cr.	C	21.40	No	21.40	Miles	AQL	Oxygen, Dissolved (W)	Montgomery City East WWTF	Montgomery	07110008	1
146	2006	1283.00	Elm Br.	C	3.00	Yes	3.00	Miles	AQL	Oxygen, Dissolved (W)	Windsor SE WWTP	Henry	10290108	1
147	2018	4110.00	Engelholm Creek	C	3.00	Yes	3.00	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
148	2018	4110.00	Engelholm Creek	C	3.00	Yes	3.00	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
149	2012	1704.00	Fee Fee Cr. (new)	P	1.50	Yes	1.50	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	10300200	1
150	2012	1704.00	Fee Fee Cr. (new)	P	1.50	Yes	1.50	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	10300200	1
151	2016	1704.00	Fee Fee Cr. (new)	P	1.50	Yes	1.50	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	10300200	1
152	2012	7237.00	Fellows Lake	L1	800.00	Yes	800.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Greene	10290106	1, 5
153	2016	3595.00	Fenton Cr.	P	0.50	Yes	0.50	Miles	AQL	Chloride (W)	Source Unknown	St. Louis	07140102	1
154	2012	3595.00	Fenton Cr.	P	0.50	Yes	0.50	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140102	1
155	2012	2186.00	Fishpot Cr.	P	3.50	Yes	3.50	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	07140102	1
156	2016	3220.00	Fivemile Cr.	P	5.00	No	5.00	Miles	WBC B	Escherichia coli (W)	Rural NPS	Newton	11070207	1
157	2016	0864.00	Flat Cr.	P	23.70	Yes	23.70	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Pettis/Morgan	10300103	1
158	2006	2168.00	Flat River Cr.	C	10.00	No	10.00	Miles	AQL	Cadmium (W)	Old Lead Belt tailings	St. Francois	07140104	1
159	2012	3938.00	Flat River tributary	US	0.30	Yes	0.30	Miles	GEN	Zinc (W)	Elvins Chat Pile	St. Francois	07140104	1, 7
160	2010	7151.00	Forest Lake	L1	580.00	Yes	580.00	Acres	AQL	Chlorophyll-a (W)	Rural NPS	Adair	10280202	1, 4, 5
161	2016	7151.00	Forest Lake	L1	580.00	Yes	580.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Adair	10280202	1, 5
162	2010	7151.00	Forest Lake	L1	580.00	Yes	580.00	Acres	AQL	Nitrogen, Total (W)	Rural NPS	Adair	10280202	1, 4, 5
163	2010	7151.00	Forest Lake	L1	580.00	Yes	580.00	Acres	AQL	Phosphorus, Total (W)	Rural NPS	Adair	10280202	1, 4, 5
164	2016	3943.00	Foster Branch tributary	C	2.00	No	2.00	Miles	AQL	Oxygen, Dissolved (W)	Ashland WWTF	Boone	10300102	1
165	2018	7324.00	Fourche Lake	L3	49.00	Yes	49.00	Acres	AQL	Chlorophyll-a (W)	Source Unknown	Ripley	11010009	1, 4
166	2018	7324.00	Fourche Lake	L3	49.00	Yes	49.00	Acres	AQL	Nitrogen, Total (W)	Source Unknown	Ripley	11010009	1, 4
167	2006	0747.00	Fowler Cr.	C	6.00	Yes	6.00	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Boone	10300102	1

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
168	2010	7382.00	Foxboro Lake	L3	22.00	Yes	22.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Franklin	07140103	1
169	2008	0038.00	Fox R.	P	42.00	Yes	42.00	Miles	WBC B	Escherichia coli (W)	Rural NPS	Clark	07110001	1
170	2014	7008.00	Fox Valley Lake	L3	89.00	Yes	89.00	Acres	AQL	Chlorophyll-a (W)	Rural NPS	Clark	07110001	1, 4
171	2014	7008.00	Fox Valley Lake	L3	89.00	Yes	89.00	Acres	AQL	Nitrogen, Total (W)	Rural NPS	Clark	07110001	1, 4
172	2010	7008.00	Fox Valley Lake	L3	89.00	Yes	89.00	Acres	AQL	Phosphorus, Total (W)	Rural NPS	Clark	07110001	1, 4
173	2002	7280.00	Frisco Lake	L3	5.00	Yes	5.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Phelps	07140102	1
174	2016	4061.00	Gailey Branch	C	3.20	Yes	3.20	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Pike	07110007	1
175	2012	1004.00	Gans Cr.	C	5.50	Yes	5.50	Miles	WBC A	Escherichia coli (W)	Rural NPS	Boone	10300102	1
176	2002	1455.00	Gasconade R.	P	264.00	Yes	264.00	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Pulaski	10290203	1, 5
177	2006	2184.00	Grand Glaize Cr.	C	4.00	Yes	4.00	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	07140102	1
178	2008	2184.00	Grand Glaize Cr.	C	4.00	Yes	4.00	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140102	1
179	2002	2184.00	Grand Glaize Cr.	C	4.00	Yes	4.00	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Louis	07140102	1
180	2006	0593.00	Grand R.	P	56.00	Yes	56.00	Miles	WBC A	Escherichia coli (W)	Rural NPS	Livingston/Chariton	10280103	1, 5
181	2008	1712.00	Gravois Cr.	P	2.30	Yes	2.30	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	07140101	1
182	2006	1712.00	Gravois Cr.	P	2.30	Yes	2.30	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	07140101	1
183	2006	1713.00	Gravois Cr.	C	6.00	Yes	6.00	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
184	2006	1713.00	Gravois Cr.	C	6.00	Yes	6.00	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
185	2016	4051.00	Gravois Creek tributary	C	1.90	Yes	1.90	Miles	WBC B	Escherichia coli (W)	Municipal, Urbanized High Density Area, Urban Runoff/Storm Sewers	St. Louis	07140101	1
186	2006	1009.00	Grindstone Cr.	C	2.50	Yes	2.50	Miles	WBC A	Escherichia coli (W)	Rural NPS	Boone	10300102	1
187	2014	7386.00	Harrison County Lake	L1	280.00	Yes	280.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Harrison	10280101	1, 5
188	2010	7152.00	Hazel Creek Lake	L1	453.00	Yes	453.00	Acres	AQL	Chlorophyll-a (W)	Rural NPS	Adair	10280201	1, 4, 5
189	2018	7152.00	Hazel Creek Lake	L1	453.00	Yes	453.00	Acres	AQL	Nitrogen, Total (W)	Nonpoint Source	Adair	10280201	1, 4, 5
190	2016	2196.00	Headwater Div. Chan.	P	20.30	Yes	20.30	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Cape Girardeau	07140105	1, 5
191	2008	0848.00	Heaths Cr.	P	21.00	Yes	21.00	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Pettis/Cooper	10300103	1
192	2006	3226.00	Hickory Cr.	P	4.90	Yes	4.90	Miles	WBC A	Escherichia coli (W)	Rural NPS	Newton	11070207	1
193	2016	1007.00	Hinkson Cr.	P	7.60	Yes	7.60	Miles	WBC B	Escherichia coli (W)	Nonpoint Source	Boone	10300102	1
194	2012	1008.00	Hinkson Cr.	C	18.80	Yes	18.80	Miles	WBC A	Escherichia coli (W)	Nonpoint Source	Boone	10300102	1
195	2016	7193.00	Holden City Lake	L1	290.20	Yes	290.20	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Johnson	10300104	1, 5
196	2012	1011.00	Hominy Br.	C	1.00	Yes	1.00	Miles	WBC B	Escherichia coli (W)	Rural NPS	Boone	10300102	1
197	2018	1251.00	Honey Cr.	C	8.50	Yes	8.50	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Henry	10290108	1
198	2010	3169.00	Honey Cr.	P	16.50	Yes	16.50	Miles	WBC B	Escherichia coli (W)	Rural NPS	Lawrence	11070207	1
199	2010	3170.00	Honey Cr.	C	2.70	Yes	2.70	Miles	WBC B	Escherichia coli (W)	Rural NPS	Lawrence	11070207	1
200	2010	1348.00	Horse Cr.	P	27.70	Yes	27.70	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Vernon/Cedar	10290106	1, 8
201	2008	1348.00	Horse Cr.	P	27.70	Yes	27.70	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Vernon/Cedar	10290106	1

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
202	2014	3413.00	Horseshoe Cr.	C	5.80	Yes	5.80	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Lafayette/Jackson	10300101	1
203	2002	7388.00	Hough Park Lake	L3	10.00	Yes	10.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Cole	10300102	1
204	2012	7029.00	Hunnewell Lake	L3	228.00	Yes	228.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Shelby	07110004	1
205	2010	0420.00	Indian Cr.	C	3.40	Yes	3.40	Miles	AQL	Chloride (W)	Road/Bridge Runoff, Non-construction	Jackson	10300101	1
206	2002	0420.00	Indian Cr.	C	3.40	Yes	3.40	Miles	WBC A	Escherichia coli (W)	Leawood, KS WWTP	Jackson	10300101	1
207	2012	1946.00	Indian Cr.	P	1.90	Yes	1.90	Miles	AQL	Lead (S)	Doe Run Viburnum Division Lead mine	Washington	07140102	1
208	2010	1946.00	Indian Cr.	P	1.90	Yes	1.90	Miles	AQL	Zinc (S)	Doe Run Viburnum Division Lead mine	Washington	07140102	1
209	2008	7389.00	Indian Creek Community Lake	L3	185.00	Yes	185.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Livingston	10280101	1
210	2014	3223.00	Jacobs Br.	P	1.60	Yes	1.60	Miles	AQL	Cadmium (S)	Tri-State Mining District	Newton	11070207	1
211	2014	3223.00	Jacobs Br.	P	1.60	Yes	1.60	Miles	AQL	Cadmium (W)	Tri-State Mining District	Newton	11070207	1
212	2014	3223.00	Jacobs Br.	P	1.60	Yes	1.60	Miles	AQL	Lead (S)	Tri-State Mining District	Newton	11070207	1
213	2014	3223.00	Jacobs Br.	P	1.60	Yes	1.60	Miles	AQL	Zinc (S)	Tri-State Mining District	Newton	11070207	1
214	2012	3223.00	Jacobs Br.	P	1.60	Yes	1.60	Miles	AQL	Zinc (W)	Tri-State Mining District	Newton	11070207	1
215	2012	3207.00	Jenkins Cr.	P	2.80	Yes	2.80	Miles	WBC A	Escherichia coli (W)	Rural NPS	Jasper	11070207	1
216	2014	3208.00	Jenkins Cr.	C	4.80	Yes	4.80	Miles	WBC A	Escherichia coli (W)	Rural NPS	Newton/Jasper	11070207	1
217	2012	3205.00	Jones Cr.	P	7.50	Yes	7.50	Miles	WBC A	Escherichia coli (W)	Rural NPS	Newton/Jasper	11070207	1
218	2016	5006.00	Joplin Creek	C	3.90	Yes	3.90	Miles	AQL	Cadmium (W)	Mill Tailings	Jasper	11070207	1
219	2018	5006.00	Joplin Creek	C	3.90	Yes	3.90	Miles	AQL	Zinc (W)	Mill Tailings	Jasper	11070207	1
220	2014	3374.00	Jordan Cr.	P	3.80	Yes	3.80	Miles	AQL	Polycyclic Aromatic Hydrocarbons-PAHs (S)	Urban NPS	Greene	11010002	1
221	2012	3592.00	Keifer Cr.	P	1.20	Yes	1.20	Miles	AQL	Chloride (W)	Road/Bridge Runoff, Non-construction	St. Louis	07140102	1
222	2012	3592.00	Keifer Cr.	P	1.20	Yes	1.20	Miles	WBC A	Escherichia coli (W)	Rural NPS	St. Louis	07140102	1
223	2016	7657.00	Knox Village Lake	L3	3.00	Yes	3.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	10300101	1
224	2016	2171.00	Koen Cr.	C	1.00	Yes	1.00	Miles	AQL	Lead (S)	Mine Tailings	St. Francois	07140104	1
225	2016	7023.00	Labelle Lake #2	L1	98.00	Yes	98.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Lewis	07110003	1, 5
226	2016	7659.00	Lake Boutin	L3	20.00	Yes	20.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Cape Girardeau	07140105	1
227	2002	7469.00	Lake Buteo	L3	7.00	Yes	7.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Johnson	10300104	1
228	2018	7049.00	Lake Lincoln	L3	88.00	Yes	88.00	Acres	AQL	Chlorophyll-a (W)	Source Unknown	Lincoln	07110008	1, 4
229	2002	7436.00	Lake of the Woods	L3	3.00	Yes	3.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Boone	10300102	1
230	2008	7629.00	Lake of the Woods	UL	7.00	Yes	7.00	Acres	GEN	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	10300101	1, 7
231	2016	7132.00	Lake Paho	L3	273.00	Yes	273.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Mercer	10280102	1
232	2014	7055.00	Lake Ste. Louise	L3	71.00	Yes	71.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Charles	07110009	1

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
233	2016	7035.00	Lake Tom Sawyer	L3	4.00	Yes	4.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Monroe	07110006	1
234	2010	7212.00	Lake Winnebago	L3	272.00	Yes	272.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Cass	10290108	1
235	2006	0847.00	Lamine R.	P	64.00	Yes	64.00	Miles	WBC A	Escherichia coli (W)	Rural NPS	Morgan/Cooper	10300103	1
236	2018	3105.00	Lateral #2 Main Ditch	P	11.50	Yes	11.50	Miles	AQL	Ammonia, Total (W)	Source Unknown	Stoddard	08020204	1
237	2006	3105.00	Lateral #2 Main Ditch	P	11.50	Yes	11.50	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Stoddard	08020204	1
238	2014	1529.00	L. Beaver Cr.	C	3.50	Yes	3.50	Miles	WBC A	Escherichia coli (W)	Source Unknown	Phelps	10290203	1
239	2008	1529.00	L. Beaver Cr.	C	3.50	Yes	3.50	Miles	AQL	Sedimentation/Siltation (S)	Smith Sand and Gravel	Phelps	10290203	1
240	2012	0422.00	L. Blue R.	P	35.10	Yes	35.10	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
241	2018	0422.00	L. Blue R.	P	35.10	Yes	35.10	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
242	2012	1003.00	L. Bonne Femme Cr.	P	9.00	Yes	9.00	Miles	WBC B	Escherichia coli (W)	Source Unknown	Boone	10300102	1
243	2006	1863.00	L. Dry Fk.	P	5.20	No	5.20	Miles	AQL	Oxygen, Dissolved (W)	Rolla SE WWTP	Phelps	07140102	1
244	2006	1864.00	L. Dry Fk.	C	4.70	No	4.70	Miles	AQL	Oxygen, Dissolved (W)	Rolla SE WWTP	Phelps	07140102	1
245	2008	1864.00	L. Dry Fk.	C	4.70	Yes	4.70	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Phelps	07140102	1
246	2006	1325.00	L. Dry Wood Cr.	P	20.50	Yes	20.50	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Vernon	10290104	1
247	2010	1326.00	L. Dry Wood Cr.	C	15.60	Yes	15.60	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Barton/Vernon	10290104	1
248	2012	3137.00	Lee Rowe Ditch	C	6.00	Yes	6.00	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Mississippi	08020201	1
249	2018	7346.00	Lewis Lake	L3	6.00	Yes	6.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Stoddard	08020204	1
250	2002	7020.00	Lewistown Lake	L1	35.00	Yes	35.00	Acres	DWS	Atrazine (W)	Rural NPS	Lewis	07110002	2, 5
251	2012	3575.00	Line Cr.	C	7.00	Yes	7.00	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Platte	10240011	1
252	2018	4115.00	Little Antire Creek	C	4.00	Yes	4.00	Miles	WBC B	Escherichia coli (W)	Nonpoint Source	Jefferson/St. Louis	07140102	1
253	2018	4107.00	Little Blue River tributary	C	5.50	Yes	5.50	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
254	2018	4107.00	Little Blue River tributary	C	5.50	Yes	5.50	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
255	2010	3279.00	L. Lost Cr.	P	5.80	Yes	5.80	Miles	WBC B	Escherichia coli (W)	Rural NPS	Newton	11070206	1
256	2006	0623.00	L. Medicine Cr.	P	39.80	Yes	39.80	Miles	WBC B	Escherichia coli (W)	Rural NPS	Mercer/Grundy	10280103	1
257	2006	1189.00	L. Niangua R.	P	43.80	Yes	43.80	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Dallas/Camden	10290110	1
258	2006	0606.00	Locust Cr.	P	91.70	No	91.70	Miles	SCR	Escherichia coli (W)	Rural NPS	Putnam/Sullivan	10280103	1, 5
259	2006	0606.00	Locust Cr.	P	91.70	No	91.70	Miles	WBC B	Escherichia coli (W)	Rural NPS	Putnam/Sullivan	10280103	1, 5
260	2012	2763.00	Logan Cr.	P	36.00	No	36.00	Miles	AQL	Lead (S)	Sweetwater Lead Mine/Mill	Reynolds	11010007	1
261	2006	0696.00	Long Branch Cr.	C	14.80	No	14.80	Miles	AQL	Oxygen, Dissolved (W)	Atlanta WWTP	Macon	10280203	1
262	2002	7097.00	Longview Lake	L2	953.00	Yes	953.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	10300101	1
263	2008	3652.00	L. Osage R.	C	23.60	Yes	23.60	Miles	WBC B	Escherichia coli (W)	Rural NPS	Vernon	10290103	1
264	2006	3278.00	Lost Cr.	P	8.50	Yes	8.50	Miles	WBC A	Escherichia coli (W)	Rural NPS	Newton	11070206	1
265	2014	2854.00	L. St. Francis R.	P	32.40	No	32.40	Miles	AQL	Lead (S)	Catherine Lead Mine, pos. Mine La Motte	Madison	08020202	1, 5
266	2006	2814.00	Main Ditch	C	13.00	Yes	13.00	Miles	AQL	pH (W)	Poplar Bluff WWTP	Butler	11010007	1
267	2006	2814.00	Main Ditch	C	13.00	Yes	13.00	Miles	AQL	Temperature, water (W)	Channelization	Butler	11010007	1
268	2012	1709.00	Maline Cr.	C	0.60	Yes	0.60	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	07140101	1

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
269	2012	3839.00	Maline Cr.	C	0.50	Yes	0.50	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis City	07140101	1
270	2016	3839.00	Maline Cr.	C	0.50	Yes	0.50	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis City	07140101	1
271	2016	7398.00	Maple Leaf Lake	L3	127.00	Yes	127.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Lafayette	10300104	1
272	2002	7033.00	Mark Twain Lake	L2	18132.00	Yes	18132.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Ralls	07110005	1, 5
273	2018	4109.00	Martigney Creek	C	1.60	Yes	1.60	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
274	2018	4109.00	Martigney Creek	C	1.60	Yes	1.60	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
275	2014	3596.00	Mattese Cr.	P	1.10	Yes	1.10	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140102	1
276	2016	1786.00	McClanahan Cr.	C	2.50	Yes	2.50	Miles	SCR	Escherichia coli (W)	Source Unknown	Perry	07140105	1
277	2016	1786.00	McClanahan Cr.	C	2.50	Yes	2.50	Miles	WBC B	Escherichia coli (W)	Source Unknown	Perry	07140105	1
278	2006	0619.00	Medicine Cr.	P	43.80	Yes	43.80	Miles	WBC B	Escherichia coli (W)	Rural NPS	Putnam/Grundy	10280103	1
279	2016	2183.00	Meramec R.	P	22.80	Yes	22.80	Miles	WBC A	Escherichia coli (W)	Source Unknown	St. Louis	07140102	1, 5
280	2008	2183.00	Meramec R.	P	22.80	Yes	22.80	Miles	AQL	Lead (S)	Old Lead belt tailings	St. Louis	07140102	1, 5
281	2010	0123.00	M. Fk. Salt R.	C	25.40	No	25.40	Miles	AQL	Oxygen, Dissolved (W)	Macon WWTP	Macon	07110006	1
282	2008	1299.00	Miami Cr.	P	19.60	Yes	19.60	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Bates	10290102	1
283	2006	0468.00	Middle Fk. Grand R.	P	27.50	Yes	27.50	Miles	WBC A	Escherichia coli (W)	Rural NPS	Worth/Gentry	10280101	1
284	2010	3262.00	Middle Indian Cr.	C	3.50	Yes	3.50	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Newton	11070208	1, 8
285	2010	3263.00	Middle Indian Cr.	P	2.20	Yes	2.20	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Newton	11070208	1, 8
286	2008	3263.00	Middle Indian Cr.	P	2.20	Yes	2.20	Miles	WBC B	Escherichia coli (W)	Rural NPS	Newton	11070208	1
287	2016	4066.00	Mill Creek	C	3.40	Yes	3.40	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
288	2016	4066.00	Mill Creek	C	3.40	Yes	3.40	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
289	2016	4066.00	Mill Creek	C	3.40	Yes	3.40	Miles	AQL	Oxygen, Dissolved (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
290	2014	1707.03	Mississippi R.	P	44.60	Yes	44.60	Miles	WBC B	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	St. Louis/Ste. Genevieve	07140101	1, 5
291	2010	0226.00	Missouri R.	P	184.50	Yes	184.50	Miles	WBC B	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	Atchison/Jackson	10240011	1, 5
292	2012	0356.00	Missouri R.	P	129.00	Yes	129.00	Miles	SCR	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	Jackson/Chariton	10300101	1, 5
293	2012	0356.00	Missouri R.	P	129.00	Yes	129.00	Miles	WBC B	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	Jackson/Chariton	10300101	1, 5
294	2008	1604.00	Missouri R.	P	104.50	No	104.50	Miles	WBC B	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	St. Charles/St. Louis	10300200	1, 5
295	2014	7031.00	Monroe City Lake	L1	94.00	Yes	94.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Ralls	07110007	1, 5
296	2018	7301.00	Monsanto Lake	L3	18.00	Yes	18.00	Acres	AQL	Chlorophyll-a (W)	Source Unknown	St. Francois	07140104	1, 4, 6
297	2016	7301.00	Monsanto Lake	L3	18.00	Yes	18.00	Acres	AQL	Nitrogen, Total (W)	Source Unknown	St. Francois	07140104	1, 4, 6
298	2018	7301.00	Monsanto Lake	L3	18.00	Yes	18.00	Acres	AQL	Phosphorus, Total (W)	Source Unknown	St. Francois	07140104	1, 4, 6

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
299	2010	7402.00	Mozingo Lake	L1	898.00	Yes	898.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Nodaway	10240013	1, 5
300	2018	0853.00	Muddy Cr.	P	62.20	Yes	62.20	Miles	WBC B	Escherichia coli (W)	Rural NPS	Pettis	10300103	1
301	2016	0158.00	N. Fk. Cuivre R.	P	25.10	Yes	25.10	Miles	WBC A	Escherichia coli (W)	Rural NPS	Pike/Lincoln	07110008	1
302	2018	0110.00	N. Fk. Salt R.	P	84.90	Yes	84.90	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Shelby/Monroe	07110005	1, 5
303	2008	3186.00	N. Fk. Spring R.	P	17.40	Yes	17.40	Miles	WBC B	Escherichia coli (W)	Rural NPS	Jasper	11070207	1
304	2008	3188.00	N. Fk. Spring R.	C	55.90	Yes	55.90	Miles	WBC B	Escherichia coli (W)	Rural NPS	Dade/Jasper	11070207	1
305	2006	3188.00	N. Fk. Spring R.	C	55.90	Yes	55.90	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Dade/Jasper	11070207	1
306	2006	1170.00	Niangua R.	P	56.00	Yes	56.00	Miles	WBC A	Escherichia coli (W)	Rural NPS	Webster/Dallas	10290110	1
307	2012	3260.00	N. Indian Cr.	P	5.20	Yes	5.20	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Newton	11070208	1, 8
308	2008	3260.00	N. Indian Cr.	P	5.20	Yes	5.20	Miles	WBC B	Escherichia coli (W)	Rural NPS	Newton	11070208	1
309	2014	0227.00	Nishnabotna R.	P	10.20	Yes	10.20	Miles	WBC B	Escherichia coli (W)	Rural NPS	Atchison	10240004	1, 5
310	2018	0227.00	Nishnabotna R.	P	10.20	Yes	10.20	Miles	SCR	Escherichia coli (W)	Rural NPS	Atchison	10240004	1, 5
311	2014	7316.00	Noblett Lake	L3	26.00	Yes	26.00	Acres	AQL	Chlorophyll-a (W)	Nonpoint Source	Douglas	11010006	1, 4
312	2002	7316.00	Noblett Lake	L3	26.00	Yes	26.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Douglas	11010006	1
313	2014	7316.00	Noblett Lake	L3	26.00	Yes	26.00	Acres	AQL	Phosphorus, Total (W)	Nonpoint Source	Douglas	11010006	1, 4
314	2006	0550.00	No Cr.	P	28.70	Yes	28.70	Miles	WBC B	Escherichia coli (W)	Rural NPS	Grundy/Livingston	10280102	1
315	2018	0550.00	No Cr.	P	28.70	Yes	28.70	Miles	SCR	Escherichia coli (W)	Source Unknown	Grundy/Livingston	10280102	1
316	2010	0550.00	No Cr.	P	28.70	Yes	28.70	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Grundy/Livingston	10280102	1
317	2010	0279.00	Nodaway R.	P	59.30	Yes	59.30	Miles	WBC B	Escherichia coli (W)	Rural NPS	Nodaway/Andrew	10240010	1
318	2016	7317.00	Norfolk Lake	L2	1000.00	Yes	1000.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Ozark	11010006	1
319	2010	7109.00	North Bethany City Reservoir	L3	78.00	Yes	78.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Harrison	10280101	1
320	2014	3811.00	North Branch Wilsons Cr.	P	3.80	Yes	3.80	Miles	AQL	Zinc (S)	Urban NPS	Greene	11010002	1
321	2016	1794.00	Omete Cr.	C	1.20	Yes	1.20	Miles	SCR	Escherichia coli (W)	Source Unknown	Perry	07140105	1
322	2016	1794.00	Omete Cr.	C	1.20	Yes	1.20	Miles	WBC B	Escherichia coli (W)	Source Unknown	Perry	07140105	1
323	2018	3190.00	Opossum Cr.	C	6.40	Yes	6.40	Miles	WBC B	Escherichia coli (W)	Rural NPS	Jasper	11070207	1
324	2016	1293.00	Osage R.	P	50.70	Yes	50.70	Miles	WBC A	Escherichia coli (W)	Source Unknown	Vernon/St. Clair	10290105	1
325	2010	1293.00	Osage R.	P	50.70	Yes	50.70	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Vernon/St. Clair	10290105	1
326	2006	1373.00	Panther Cr.	C	9.70	Yes	9.70	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Polk/St. Clair	10290106	1
327	2008	2373.00	Pearson Cr.	P	8.00	Yes	8.00	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Greene	11010002	1, 8
328	2006	2373.00	Pearson Cr.	P	8.00	Yes	8.00	Miles	WBC A	Escherichia coli (W)	Rural NPS	Greene	11010002	1
329	2016	0099.00	Peno Cr.	C	14.40	Yes	14.40	Miles	AQL	Oxygen, Dissolved (W)	Northeast Correctional Center WWTP	Pike	07110007	1
330	2016	7273.00	Perry County Community Lake	L3	89.00	Yes	89.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Perry	07140105	1
331	2008	7628.00	Perry Phillips Lake	UL	32.00	Yes	32.00	Acres	GEN	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Boone	10300102	1, 7
332	2012	0215.00	Peruque Cr.	P1	9.60	Yes	9.60	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	St. Charles	07110009	1
333	2002	0218.00	Peruque Cr.	C	10.90	Yes	10.90	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Nonpoint Source	Warren/St. Charles	07110009	1, 8
334	2016	0218.00	Peruque Cr.	C	10.90	Yes	10.90	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Warren/St. Charles	07110009	1
335	2018	0785.00	Petite Saline Cr.	P	21.00	Yes	21.00	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Cooper/Moniteau	10300102	1

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
336	2010	2815.00	Pike Cr.	C	6.00	Yes	6.00	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Butler	11010007	1
337	2010	0312.00	Platte R.	P	142.40	Yes	142.40	Miles	WBC B	Escherichia coli (W)	Rural NPS	Worth/Platte	10240012	1, 5
338	2012	1327.00	Pleasant Run Cr.	C	7.60	Yes	7.60	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Vernon	10290104	1
339	2006	3120.00	Pole Cat Slough	P	12.60	Yes	12.60	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Dunklin	08020204	1
340	2014	3120.00	Pole Cat Slough	P	12.60	Yes	12.60	Miles	AQL	Temperature, water (W)	Source Unknown	Dunklin	08020204	1
341	2014	1440.00	Pomme de Terre R.	P	69.10	Yes	69.10	Miles	WBC A	Escherichia coli (W)	Rural NPS	Webster/Polk	10290107	1
342	2006	2038.00	Red Oak Cr.	C	10.00	Yes	10.00	Miles	AQL	Oxygen, Dissolved (W)	Owensville WWTP	Gasconade	07140103	1
343	2018	0743.00	Renfro Cr.	C	1.50	Yes	1.50	Miles	AQL	Oxygen, Dissolved (W)	Abandoned Mine Lands and Rural NPS	Callaway/Boone	10300102	1
344	2016	7204.00	Rinquelin Trail Community Lake	L3	27.00	Yes	27.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Maries	10290111	1
345	2006	1710.00	River des Peres	P	2.60	Yes	2.60	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis City	07140101	1
346	2012	1710.00	River des Peres	P	2.60	Yes	2.60	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis City	07140101	1
347	2006	3972.00	River des Peres	C	13.60	Yes	13.60	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
348	2016	3972.00	River des Peres	C	13.60	Yes	13.60	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
349	2016	3972.00	River des Peres	C	13.60	Yes	13.60	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
350	2018	4111.00	River des Peres tributary	C	1.80	Yes	1.80	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
351	2018	4111.00	River des Peres tributary	C	1.80	Yes	1.80	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
352	2018	4111.00	River des Peres tributary	C	1.80	Yes	1.80	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
353	2018	4106.00	Rock Creek	C	6.20	Yes	6.20	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson/Clay	10300101	1
354	2018	4106.00	Rock Creek	C	6.20	Yes	6.20	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson/Clay	10300101	1
355	2018	3577.00	Sadler Br.	C	0.80	Yes	0.80	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Polk	10290106	1
356	2010	0594.00	Salt Cr.	C	14.90	Yes	14.90	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Chariton	10280103	1
357	2014	0893.00	Salt Fk.	P	26.70	Yes	26.70	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Saline	10300104	1
358	2012	2113.00	Salt Pine Cr.	C	1.20	Yes	1.20	Miles	AQL	Lead (S)	Barite tailings pond	Washington	07140104	1
359	2012	2113.00	Salt Pine Cr.	C	1.20	Yes	1.20	Miles	AQL	Zinc (S)	Barite tailings pond	Washington	07140104	1
360	2008	0091.00	Salt R.	P	29.00	Yes	29.00	Miles	AQL	Oxygen, Dissolved (W)	Mark Twain Lake re-regulation dam	Ralls/Pike	07110007	1, 5
361	2012	0103.00	Salt R.	P1	9.30	Yes	9.30	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Ralls	07110007	1, 5
362	2014	0103.00	Salt R.	P1	9.30	Yes	9.30	Miles	AQL	Oxygen, Dissolved (W)	Cannon Dam	Ralls	07110007	1, 5
363	2006	0655.00	S. Blackbird Cr.	C	13.00	Yes	13.00	Miles	AQL	Ammonia, Total (W)	Source Unknown	Putnam	10280201	1
364	2006	0142.00	S. Fk. Salt R.	C	40.10	No	40.10	Miles	AQL	Oxygen, Dissolved (W)	Mexico WWTP, Rural Nonpoint Source	Callaway/Audrain	07110006	1
365	2006	1249.00	S. Grand R.	P	66.80	Yes	66.80	Miles	WBC B	Escherichia coli (W)	Rural NPS	Cass/Henry	10290108	1
366	2014	3222.00	Shoal Cr.	P	50.50	No	50.50	Miles	AQL	Zinc (S)	Mill Tailings	Newton	11070207	1, 5
367	2018	3244.00	Silver Cr.	P	1.90	Yes	1.90	Miles	AQL	Zinc (S)	Mill Tailings	Newton	11070207	1
368	2012	3259.00	S. Indian Cr.	P	8.70	Yes	8.70	Miles	AQL	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	McDonald/Newton	11070208	1, 8
369	2008	3259.00	S. Indian Cr.	P	8.70	Yes	8.70	Miles	WBC B	Escherichia coli (W)	Rural NPS	McDonald/Newton	11070208	1

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
370	2014	3754.00	Slater Br.	C	3.70	Yes	3.70	Miles	WBC B	Escherichia coli (W)	Nonpoint Source	Jasper	11070207	1
371	2006	0399.00	Sni-a-bar Cr.	P	36.60	Yes	36.60	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Jackson/Lafayette	10300101	1
372	2012	0224.00	Spencer Cr.	C	1.50	Yes	1.50	Miles	AQL	Chloride (W)	Road/Bridge Runoff, Non-construction	St. Charles	07110009	1
373	2018	5004.00	Spring Branch	C	6.70	Yes	6.70	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
374	2018	5004.00	Spring Branch	C	6.70	Yes	6.70	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	10300101	1
375	2016	5007.00	Spring Branch	C	3.10	No	3.10	Miles	WBC B	Escherichia coli (W)	Source Unknown	St. Louis	07140102	1
376	2006	3160.00	Spring R.	P	61.70	Yes	61.70	Miles	WBC A	Escherichia coli (W)	Rural NPS	Lawrence/Jasper	11070207	1
377	2010	3164.00	Spring R.	P	8.80	Yes	8.80	Miles	WBC A	Escherichia coli (W)	Rural NPS	Lawrence	11070207	1
378	2010	3165.00	Spring R.	P	11.90	Yes	11.90	Miles	WBC A	Escherichia coli (W)	Rural NPS	Lawrence	11070207	1
379	2018	4112.00	Spring River tributary	C	4.00	Yes	4.00	Miles	WBC B	Escherichia coli (W)	Nonpoint Source	Jasper	11070207	1
380	2018	2677.00	Spring Valley Cr.	P	10.80	Yes	10.80	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Shannon	11010008	1
381	2006	3135.00	Stevenson Bayou	C	6.40	Yes	6.40	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Mississippi	08020201	1
382	2012	2835.00	St. Francis R.	P	93.10	No	93.10	Miles	CLF	Temperature, water (W)	Source Unknown	St. Francois	08020202	1
383	2006	3138.00	St. Johns Ditch	P	15.30	Yes	15.30	Miles	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	New Madrid	08020201	1
384	2006	0959.00	Straight Fk.	C	6.00	Yes	6.00	Miles	AQL	Oxygen, Dissolved (W)	Versailles WWTP	Morgan	10300102	1
385	2006	0686.00	Sugar Cr.	P	6.80	Yes	6.80	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Randolph	10280203	1
386	2018	0686.00	Sugar Cr.	P	6.80	Yes	6.80	Miles	AQL	Sulfate + Chloride (W)	Source Unknown	Randolph	10280203	1
387	2018	4108.00	Sugar Creek	C	1.80	Yes	1.80	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
388	2018	4108.00	Sugar Creek	C	1.80	Yes	1.80	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
389	2018	4117.00	Sugar Creek	C	3.60	Yes	3.60	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140102	1
390	2018	4117.00	Sugar Creek	C	3.60	Yes	3.60	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140102	1
391	2014	7166.00	Sugar Creek Lake	L1	308.00	Yes	308.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Randolph	10280203	1, 5
392	2006	7399.00	Sunset Lake	L3	6.00	Yes	6.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Cole	10300102	1
393	2002	7313.00	Table Rock Lake	L2	41747.00	No	41747.00	Acres	AQL	Chlorophyll-a (W)	Municipal Point Source Discharges, Nonpoint Source	Stone	11010001	1, 4
394	2002	7313.00	Table Rock Lake	L2	41747.00	No	41747.00	Acres	AQL	Nitrogen, Total (W)	Municipal Point Source Discharges, Nonpoint Source	Stone	11010001	1, 4
395	2002	7313.00	Table Rock Lake	L2	41747.00	Yes	41747.00	Acres	AQL	Nutrient/Eutrophication Biol. Indicators (W)	Municipal Point Source Discharges, Nonpoint Source	Stone	11010001	1, 4
396	2016	7352.00	Thirtyfour Corner Blue Hole	L3	9.00	Yes	9.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Mississippi	08010100	1
397	2008	0549.00	Thompson R.	P	70.60	No	70.60	Miles	WBC B	Escherichia coli (W)	Rural NPS	Harrison	10280102	1, 5
398	2012	3243.00	Thurman Cr.	P	3.00	Yes	3.00	Miles	WBC B	Escherichia coli (W)	Rural NPS	Newton	11070207	1
399	2018	2114.00	Trib. Old Mines Cr.	C	1.50	Yes	1.50	Miles	AQL	Lead (S)	Barite tailings pond	Washington	07140104	1
400	2010	2114.00	Trib. Old Mines Cr.	C	1.50	Yes	1.50	Miles	AQL	Sedimentation/Siltation (S)	Barite tailings pond	Washington	07140104	1
401	2018	2114.00	Trib. Old Mines Cr.	C	1.50	Yes	1.50	Miles	AQL	Zinc (S)	Barite tailings pond	Washington	07140104	1
402	2010	1420.00	Trib. to Goose Cr.	C	3.00	Yes	3.00	Miles	WBC B	Escherichia coli (W)	Rural NPS	Lawrence	10290106	1
403	2006	3490.00	Trib. to L. Muddy Cr.	C	1.00	Yes	1.00	Miles	AQL	Chloride (W)	Tyson Foods	Pettis	10300103	1

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
404	2014	3981.00	Trib. to Shoal Cr.	US	1.56	Yes	1.56	Miles	GEN	Cadmium (W)	Tanyard Hollow Pits	Jasper/Newton	11070207	1, 7
405	2014	3981.00	Trib. to Shoal Cr.	US	1.56	Yes	1.56	Miles	GEN	Zinc (W)	Tanyard Hollow Pits	Jasper/Newton	11070207	1, 7
406	2014	3982.00	Trib. to Shoal Cr.	US	2.20	Yes	2.20	Miles	GEN	Zinc (W)	Maiden Lane Pits	Jasper/Newton	11070207	1, 7
407	2014	3983.00	Trib. to Turkey Cr.	US	2.90	Yes	2.90	Miles	GEN	Cadmium (S)	Abandoned Smelter Site	Jasper	11070207	1, 7
408	2016	3983.00	Trib. to Turkey Cr.	US	2.90	Yes	2.90	Miles	GEN	Cadmium (W)	Abandoned Smelter Site	Jasper	11070207	1, 7
409	2014	3983.00	Trib. to Turkey Cr.	US	2.90	Yes	2.90	Miles	GEN	Lead (S)	Abandoned Smelter Site	Jasper	11070207	1, 7
410	2014	3983.00	Trib. to Turkey Cr.	US	2.90	Yes	2.90	Miles	GEN	Zinc (S)	Abandoned Smelter Site	Jasper	11070207	1, 7
411	2014	3983.00	Trib. to Turkey Cr.	US	2.90	Yes	2.90	Miles	GEN	Zinc (W)	Abandoned Smelter Site	Jasper	11070207	1, 7
412	2016	3984.00	Trib. to Turkey Cr.	US	2.20	Yes	2.20	Miles	GEN	Cadmium (W)	Mill Tailings	Jasper	11070207	1, 7
413	2014	3984.00	Trib. to Turkey Cr.	US	2.20	Yes	2.20	Miles	GEN	Zinc (W)	Leadwood Hollow pits	Jasper	11070207	1, 7
414	2014	3985.00	Trib. to Turkey Cr.	US	1.60	Yes	1.60	Miles	GEN	Zinc (W)	Chitwood Hollow pits	Jasper	11070207	1, 7
415	2006	0956.00	Trib. to Willow Fk.	C	0.50	Yes	0.50	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Moniteau	10300102	1
416	2006	3589.00	Trib. to Wolf Cr.	C	1.50	Yes	1.50	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	St. Francois	08020202	2
417	2006	0074.00	Troublesome Cr.	C	41.30	No	41.30	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Knox	07110003	1
418	2012	0074.00	Troublesome Cr.	C	41.30	Yes	41.30	Miles	AQL	Sedimentation/Siltation (S)	Habitat Mod. - other than Hydromod.	Knox/Marion	07110003	1
419	2016	3174.00	Truitt Cr.	P	1.50	Yes	1.50	Miles	WBC B	Escherichia coli (W)	Rural NPS	Lawrence	11070207	1
420	2012	3175.00	Truitt Cr.	C	6.40	Yes	6.40	Miles	SCR	Escherichia coli (W)	Rural NPS	Lawrence	11070207	1
421	2012	0751.00	Turkey Cr.	C	6.30	Yes	6.30	Miles	WBC A	Escherichia coli (W)	Source Unknown	Boone	10300102	1
422	2018	2985.00	Turkey Cr.	C	3.10	No	3.10	Miles	AQL	Ammonia, Total (W)	Puxico WWTF	Stoddard	08020203	1
423	2018	2985.00	Turkey Cr.	C	3.10	No	3.10	Miles	AQL	Oxygen, Dissolved (W)	Puxico WWTF	Stoddard	08020203	1
424	2006	3216.00	Turkey Cr.	P	7.70	Yes	7.70	Miles	AQL	Cadmium (S)	Tri-State Mining District	Jasper	11070207	1
425	2006	3216.00	Turkey Cr.	P	7.70	Yes	7.70	Miles	AQL	Cadmium (W)	Tri-State Mining District	Jasper	11070207	1
426	2006	3216.00	Turkey Cr.	P	7.70	Yes	7.70	Miles	WBC B	Escherichia coli (W)	Nonpoint Source	Jasper	11070207	1
427	2008	3216.00	Turkey Cr.	P	7.70	Yes	7.70	Miles	AQL	Lead (S)	Tri-State Mining District	Jasper	11070207	1
428	2006	3216.00	Turkey Cr.	P	7.70	Yes	7.70	Miles	AQL	Zinc (S)	Tri-State Mining District	Jasper	11070207	1
429	2006	3217.00	Turkey Cr.	P	6.10	Yes	6.10	Miles	AQL	Cadmium (S)	Tri-State Mining District	Jasper	11070207	1
430	2006	3217.00	Turkey Cr.	P	6.10	Yes	6.10	Miles	WBC A	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jasper	11070207	1
431	2006	3217.00	Turkey Cr.	P	6.10	Yes	6.10	Miles	AQL	Lead (S)	Tri-State Mining District	Jasper	11070207	1
432	2006	3217.00	Turkey Cr.	P	6.10	Yes	6.10	Miles	AQL	Zinc (S)	Tri-State Mining District	Jasper	11070207	1
433	2016	3282.00	Turkey Cr.	P	2.40	Yes	2.40	Miles	AQL	Cadmium (S)	Bonne Terre chat pile	St. Francois	07140104	1
434	2006	3282.00	Turkey Cr.	P	2.40	Yes	2.40	Miles	AQL	Cadmium (W)	Bonne Terre chat pile	St. Francois	07140104	1
435	2016	3282.00	Turkey Cr.	P	2.40	Yes	2.40	Miles	AQL	Copper (S)	Bonne Terre chat pile	St. Francois	07140104	1
436	2016	3282.00	Turkey Cr.	P	2.40	Yes	2.40	Miles	AQL	Lead (S)	Bonne Terre chat pile	St. Francois	07140104	1
437	2006	3282.00	Turkey Cr.	P	2.40	Yes	2.40	Miles	AQL	Lead (W)	Bonne Terre chat pile	St. Francois	07140104	1
438	2016	3282.00	Turkey Cr.	P	2.40	Yes	2.40	Miles	AQL	Nickel (S)	Bonne Terre chat pile	St. Francois	07140104	1
439	2016	3282.00	Turkey Cr.	P	2.40	Yes	2.40	Miles	AQL	Zinc (S)	Bonne Terre chat pile	St. Francois	07140104	1

Row #	Year	WBID	Waterbody	Class	Imp. Size	Entire WB Impaired	WB Size	Units	IU	Pollutant	Source	County Up/Down	WBD 8	Comment
440	2006	3282.00	Turkey Cr.	P	2.40	No	2.40	Miles	AQL	Zinc (W)	Bonne Terre chat pile	St. Francois	07140104	1
441	2010	1414.00	Turnback Cr.	P	19.90	Yes	19.90	Miles	WBC A	Escherichia coli (W)	Rural NPS	Lawrence/Dade	10290106	1
442	2016	4079.00	Twomile Creek	C	5.60	Yes	5.60	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
443	2016	7099.00	Unity Village Lake #2	L1	26.00	Yes	26.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	10300101	1, 5
444	2006	1708.00	Watkins Cr.	C	1.40	Yes	1.40	Miles	AQL	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	07140101	1
445	2016	4097.00	Watkins Creek tributary	C	1.20	Yes	1.20	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
446	2016	4097.00	Watkins Creek tributary	C	1.20	Yes	1.20	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
447	2016	4098.00	Watkins Creek tributary	C	1.20	Yes	1.20	Miles	SCR	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
448	2016	4098.00	Watkins Creek tributary	C	1.20	Yes	1.20	Miles	WBC B	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	07140101	1
449	2012	7071.00	Weatherby Lake	L3	185.00	Yes	185.00	Acres	AQL	Chlorophyll-a (W)	Urban Runoff/Storm Sewers	Platte	10240011	1, 4
450	2012	7071.00	Weatherby Lake	L3	185.00	Yes	185.00	Acres	HHP	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Platte	10240011	1
451	2010	7071.00	Weatherby Lake	L3	185.00	Yes	185.00	Acres	AQL	Nitrogen, Total (W)	Urban Runoff/Storm Sewers	Platte	10240011	1, 4
452	2014	7071.00	Weatherby Lake	L3	185.00	Yes	185.00	Acres	AQL	Phosphorus, Total (W)	Urban Runoff/Storm Sewers	Platte	10240011	1, 4
453	2006	0560.00	Weldon R.	P	43.40	Yes	43.40	Miles	WBC B	Escherichia coli (W)	Rural NPS	Mercer/Grundy	10280102	1
454	2008	2755.00	W. Fk. Black R.	P	32.30	No	32.30	Miles	AQL	Lead (S)	West Fork Lead Mine/Mill	Reynolds	11010007	1
455	2008	2755.00	W. Fk. Black R.	P	32.30	No	32.30	Miles	AQL	Nickel (S)	West Fork Lead Mine/Mill	Reynolds	11010007	1
457	2006	1317.00	W. Fk. Dry Wood Cr.	C	8.10	Yes	8.10	Miles	AQL	Oxygen, Dissolved (W)	Source Unknown	Vernon	10290104	1
458	2008	1504.00	Whetstone Cr.	P	12.20	Yes	12.20	Miles	AQL	Oxygen, Dissolved (W)	Rural NPS	Wright	10290201	1
459	2010	3182.00	White Oak Cr.	C	18.00	Yes	18.00	Miles	WBC A	Escherichia coli (W)	Rural NPS	Lawrence/Jasper	11070207	1
460	2012	1700.00	Wildhorse Cr.	C	3.90	Yes	3.90	Miles	WBC B	Escherichia coli (W)	Rural, Residential Areas	St. Louis	10300200	1
461	2010	3171.00	Williams Cr.	P	1.00	Yes	1.00	Miles	WBC A	Escherichia coli (W)	Rural NPS	Lawrence	11070207	1
462	2010	3172.00	Williams Cr.	P	8.50	Yes	8.50	Miles	WBC A	Escherichia coli (W)	Rural NPS	Lawrence	11070207	1
463	2012	3594.00	Williams Cr.	P	1.00	Yes	1.00	Miles	WBC B	Escherichia coli (W)	Rural NPS	St. Louis	07140102	1
464	2016	3594.00	Williams Cr.	P	1.00	Yes	1.00	Miles	SCR	Escherichia coli (W)	Rural NPS	St. Louis	07140102	1
465	2014	3280.00	Willow Br.	P	2.20	Yes	2.20	Miles	AQL	Cadmium (S)	Mill Tailings	Newton	11070206	1
466	2010	3280.00	Willow Br.	P	2.20	Yes	2.20	Miles	WBC B	Escherichia coli (W)	Rural NPS	Newton	11070206	1
467	2014	3280.00	Willow Br.	P	2.20	Yes	2.20	Miles	AQL	Zinc (S)	Mill Tailings	Newton	11070206	1
468	2006	0955.00	Willow Fk.	C	6.80	Yes	6.80	Miles	AQL	Oxygen, Dissolved (W)	Tipton WWTP	Moniteau	10300102	1
469	2006	2375.00	Wilsons Cr.	P	14.00	Yes	14.00	Miles	WBC B	Escherichia coli (W)	Nonpoint Source	Greene/Christian	11010002	1
470	2014	2375.00	Wilsons Cr.	P	14.00	No	14.00	Miles	AQL	Polycyclic Aromatic Hydrocarbons-PAHs (S)	Nonpoint Source	Greene	11010002	1
471	2014	2429.00	Woods Fk.	C	5.50	Yes	5.50	Miles	AQL	Fishes Bioassessments/ Unknown (W)	Source Unknown	Christian	11010003	1, 8

Key To List:

Bolded rows are new listings for the 2018 listing cycle

Row #: Row number that is not unique to any water, but is simply a count of the rows (listings)

Year: Year this waterbody/pollutant pair was added to the 303(d) List

WBID: Unique waterbody identification number. Clicking the link will bring up a WQA Public Search webpage with the available data for that WBID

Waterbody: Name of the waterbody.

Class: Waterbody Classification in Missouri State Water Quality Standards: P - Permanently Flowing Waters, C - Intermittently Flowing Waters, L1 - Drinking Water Reservoirs, L2 - Large Multi-purpose Lakes,

L3 - Other Recreational Lakes, US - Unclassified Stream, UL - Unclassified Lake

Imp. Size: Size of the impaired portion of the waterbody segment

Entire WB Impaired: Yes - the entire waterbody is impaired; No: Only a portion of the waterbody is impaired

WB Size: Size of entire waterbody segment

IU: Impaired Use

AQL - Protection of Aquatic Life ; CLF - Cool-Water Fishery ; DWS - Drinking Water Supply ; GEN - General Criteria ; HHP - Human-Health Protection (Fish Consumption) ; SCR - Secondary Contact Recreation

WBC A - Whole Body Contact Recreation A (Designated Public Swimming Areas) ; WBC B - Whole Body Contact Recreation B (Those areas not considered WBC A)

Pollutant: The reason\cause the water is impaired

Media Indicators: (W) - The pollutant is in the water ; (S) - The pollutant is in the sediment ; (T) - The pollutant is in the tissue of an organism ; If no media indicator is shown the pollutant is in the water

Source: The source of the pollutant causing the impairment

County Up/Down: The county of the upstream end and downstream end of the segment that is impaired. Clicking the link will bring up a map viewer displaying the location of the impaired portion of the waterbody.

Comment:

1 - 2018 Assessment indicates impairment

2 - Assessment shows existing data is insufficient to show "good cause" for delisting

3 - Biological data does not support delisting

4 - Nutrient related impairment

5 - Water is a Public Drinking Water Supply

6 - Monsanto Lake is part of the group of lakes known as the St. Joe State Park Lakes

7 - General Use pertaining to Aquatic Life

8 - These waters are listed as either "Aquatic Macroinvertebrate Bioassessment/Unknown (W)" or "Fishes Bioassessment/Unknown (W)". These waters lack the necessary information to point to a discrete pollutant and do not show signs of habitat impairment. Since we currently cannot point to a specific pollutant as the cause, we are listing the observed effect as the reason the waters are impaired.

Missouri Department of Natural Resources, Water Protection Program, (573)751-1300, www.dnr.mo.gov

http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

<http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>

10/18/2018

Appendix C
TMDL Schedule and Section 303(d) Prioritization
Tenative Schedule for the Completion of Total Maximum Daily Load Studies

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	2188.00	Antire Cr.	P	1.90	1.90	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
2024 - 2028	2668.00	Ashley Cr.	P	2.50	2.50	Escherichia coli (W)	Source Unknown	Dent	WBC B
> 10 years	7627.00	August A Busch Lake No. 37	UL	30.00	30.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Charles	GEN
> 10 years	7637.00	August A Busch Lake Number 36	UL	16.00	16.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Charles	GEN
> 10 years	4083.00	Barker Creek tributary	C	1.20	1.20	Oxygen, Dissolved (W)	Source Unknown	Henry	AQL
> 10 years	2693.00	Barn Hollow	C	8.20	8.20	Oxygen, Dissolved (W)	Source Unknown	Howell/Texas	AQL
2022	0752.00	Bass Cr.	C	4.40	4.40	Escherichia coli (W)	Rural NPS	Boone	WBC A
2020	3240.00	Baynham Br.	P	4.00	4.00	Escherichia coli (W)	Rural NPS	Newton	WBC B
2024 - 2028	3224.00	Beef Br.	P	2.50	2.50	Cadmium (S)	Mill Tailings	Newton	AQL
2024 - 2028	3224.00	Beef Br.	P	2.50	2.50	Cadmium (W)	Mill Tailings	Newton	AQL
2024 - 2028	3224.00	Beef Br.	P	2.50	2.50	Lead (S)	Mill Tailings	Newton	AQL
2024 - 2028	3224.00	Beef Br.	P	2.50	2.50	Zinc (S)	Mill Tailings	Newton	AQL
2024 - 2028	3224.00	Beef Br.	P	2.50	2.50	Zinc (W)	Mill Tailings	Newton	AQL
> 10 years	2760.00	Bee Fk.	C	8.70	8.70	Lead (W)	Fletcher Lead Mine/Mill	Reynolds	AQL
> 10 years	7309.00	Bee Tree Lake	L3	10.00	10.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Louis	HHP
> 10 years	7365.00	Belcher Branch Lake	L3	42.00	42.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Buchanan	HHP
> 10 years	7186.00	Ben Branch Lake	L3	37.00	37.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Osage	HHP
2021	3980.00	Bens Branch	C	5.80	5.80	Cadmium (S)	Oronogo/Duenweg Mining Belt	Jasper	AQL
2021	3980.00	Bens Branch	C	5.80	5.80	Cadmium (W)	Mill Tailings	Jasper	AQL
2021	3980.00	Bens Branch	C	5.80	5.80	Lead (S)	Oronogo/Duenweg Mining Belt	Jasper	AQL
2021	3980.00	Bens Branch	C	5.80	5.80	Zinc (S)	Oronogo/Duenweg Mining Belt	Jasper	AQL
2021	3980.00	Bens Branch	C	5.80	5.80	Zinc (W)	Oronogo/Duenweg Mining Belt	Jasper	AQL
2024 - 2028	2916.00	Big Cr.	P	34.10	34.10	Cadmium (S)	Glover smelter	Iron	AQL
2024 - 2028	1578.00	Big Piney R.	P	7.80	7.80	Oxygen, Dissolved (W)	Source Unknown	Texas	AQL
2023	2080.00	Big R.	P	81.30	81.30	Cadmium (S)	Old Lead Belt tailings	St. Francois/Jefferson	AQL
2023	2080.00	Big R.	P	81.30	81.30	Zinc (S)	Old Lead Belt tailings	St. Francois/Jefferson	AQL
2024 - 2028	3184.00	Blackberry Cr.	C	6.50	6.50	Chloride (W)	Asbury Power Plant	Jasper	AQL
> 10 years	3184.00	Blackberry Cr.	C	6.50	6.50	Oxygen, Dissolved (W)	Ind. Point Source Discharge and NPS	Jasper	AQL
2024 - 2028	3184.00	Blackberry Cr.	C	6.50	6.50	Sulfate + Chloride (W)	Asbury Power Plant	Jasper	AQL
2018	0111.00	Black Cr.	P	19.40	19.40	Escherichia coli (W)	Shelbyville WWTF, Nonpoint Source	Shelby	WBC B

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	3825.00	Black Cr.	P	1.60	1.60	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	AQL
2018	3825.00	Black Cr.	P	1.60	1.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	SCR
2018	3825.00	Black Cr.	P	1.60	1.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
> 10 years	2769.00	Black R.	P	47.10	47.10	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Butler	HHP
> 10 years	2784.00	Black R.	P	39.00	39.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Wayne/Butler	HHP
2022	0417.00	Blue R.	P	4.40	4.40	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	WBC B
2022	0417.00	Blue R.	P	4.40	4.40	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	SCR
2022	0418.00	Blue R.	P	9.40	9.40	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	WBC B
2022	0418.00	Blue R.	P	9.40	9.40	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	SCR
2022	0419.00	Blue R.	P	7.70	7.70	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	WBC A
2024 - 2028	1701.00	Bonhomme Cr.	C	2.50	2.50	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
2022	0750.00	Bonne Femme Cr.	P	7.80	7.80	Escherichia coli (W)	Rural NPS	Boone	WBC A
2022	0753.00	Bonne Femme Cr.	C	7.00	7.00	Escherichia coli (W)	Rural NPS	Boone	WBC B
> 10 years	2034.00	Bourbeuse R.	P	136.70	136.70	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Phelps/Franklin	HHP
> 10 years	7003.00	Bowling Green Lake - Old	L1	7.00	7.00	Chlorophyll-a (W)	Rural NPS	Pike	AQL
> 10 years	7003.00	Bowling Green Lake - Old	L1	7.00	7.00	Nitrogen, Total (W)	Rural NPS	Pike	AQL
> 10 years	7003.00	Bowling Green Lake - Old	L1	7.00	7.00	Phosphorus, Total (W)	Rural NPS	Pike	AQL
2018	1796.00	Brazeau Cr.	P	10.80	10.80	Escherichia coli (W)	Rural NPS	Perry	WBC B
2023	1371.00	Brush Cr.	P	4.70	4.70	Oxygen, Dissolved (W)	Humansville WWTP	Polk/St. Clair	AQL
2022	3986.00	Brush Creek	C	5.40	5.40	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	WBC B
> 10 years	3986.00	Brush Creek	C	5.40	5.40	Oxygen, Dissolved (W)	Nonpoint Source	Jackson	AQL
> 10 years	3986.00	Brush Creek	C	5.40	5.40	Polycyclic Aromatic Hydrocarbons-PAHs (S)	Nonpoint Source	Jackson	AQL
> 10 years	7117.00	Buffalo Bill Lake	L3	45.00	45.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	DeKalb	HHP
2024 - 2028	3273.00	Buffalo Cr.	P	8.00	8.00	Fishes Bioassessments/ Unknown (W)	Source Unknown	Newton/McDonald	AQL
2024 - 2028	1865.00	Burgher Br.	C	1.50	1.50	Oxygen, Dissolved (W)	Source Unknown	Phelps	AQL
2023	3414.00	Burr Oak Cr.	C	6.80	6.80	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	SCR
2023	3414.00	Burr Oak Cr.	C	6.80	6.80	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	WBC B
> 10 years	7057.00	Busch W.A. No. 35 Lake	L3	51.00	51.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Charles	HHP

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2020	3234.00	Capps Cr.	P	5.00	5.00	Escherichia coli (W)	Rural NPS	Barry/Newton	WBC A
2020	3241.00	Carver Br.	P	3.00	3.00	Escherichia coli (W)	Nonpoint Source	Newton	WBC A
2023	2288.00	Castor R.	P	7.50	7.50	Escherichia coli (W)	Rural NPS	Bollinger	WBC A
2024 - 2028	0737.00	Cedar Cr.	C	37.40	37.40	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Boone	AQL
2024 - 2028	1344.00	Cedar Cr.	P	31.00	31.00	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Cedar	AQL
2018	1344.00	Cedar Cr.	P	31.00	31.00	Escherichia coli (W)	Rural NPS	Cedar	WBC A
2024 - 2028	1344.00	Cedar Cr.	P	31.00	31.00	Oxygen, Dissolved (W)	Source Unknown	Cedar	AQL
2024 - 2028	1357.00	Cedar Cr.	C	16.20	16.20	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Dade/Cedar	AQL
2024 - 2028	1357.00	Cedar Cr.	C	16.20	16.20	Oxygen, Dissolved (W)	Source Unknown	Dade/Cedar	AQL
2021	3203.00	Center Cr.	P	26.80	26.80	Cadmium (S)	Tri-State Mining District	Jasper	AQL
2021	3203.00	Center Cr.	P	26.80	26.80	Cadmium (W)	Tri-State Mining District	Jasper	AQL
2020	3203.00	Center Cr.	P	26.80	26.80	Escherichia coli (W)	Nonpoint Source	Jasper	WBC A
2021	3203.00	Center Cr.	P	26.80	26.80	Lead (S)	Tri-State Mining District	Jasper	AQL
2020	3210.00	Center Cr.	P	21.00	21.00	Escherichia coli (W)	Rural NPS	Newton/Jasper	WBC A
2020	3214.00	Center Cr.	P	4.90	4.90	Escherichia coli (W)	Rural NPS	Lawrence/Newton	WBC A
2021	5003.00	Center Creek tributary	C	2.70	2.70	Cadmium (W)	Oronogo/Duenweg Mining Belt	Jasper	AQL
2021	5003.00	Center Creek tributary	C	2.70	2.70	Zinc (W)	Oronogo/Duenweg Mining Belt	Jasper	AQL
2021	3168.00	Chat Cr.	C	2.10	2.10	Cadmium (W)	Baldwin Park Mine	Lawrence	AQL
2021	3963.00	Chat Creek tributary	US	0.90	0.90	Cadmium (W)	Baldwin Park Mine	Lawrence	GEN
2021	3963.00	Chat Creek tributary	US	0.90	0.90	Zinc (W)	Baldwin Park Mine	Lawrence	GEN
> 10 years	7634.00	Chaumiere Lake	UL	3.40	3.40	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Clay	GEN
2024 - 2028	1781.00	Cinque Hommes Cr.	P	17.10	17.10	Escherichia coli (W)	Rural NPS	Perry	WBC B
2024 - 2028	1781.00	Cinque Hommes Cr.	P	17.10	17.10	Escherichia coli (W)	Rural NPS	Perry	SCR
> 10 years	1000.00	Clark Fk.	C	6.00	6.00	Oxygen, Dissolved (W)	Source Unknown	Cole	AQL
2024 - 2028	1333.00	Clear Cr.	P	28.20	28.20	Oxygen, Dissolved (W)	Source Unknown	Vernon/St. Clair	AQL
2024 - 2028	1336.00	Clear Cr.	C	22.30	22.30	Oxygen, Dissolved (W)	Source Unknown	Vernon	AQL
2020	3238.00	Clear Cr.	P	11.10	11.10	Escherichia coli (W)	Rural NPS	Lawrence/Newton	WBC B
2023	3239.00	Clear Cr.	C	3.50	3.50	Nutrient/Eutrophication Biol. Indicators (W)	Monett WWTP	Barry/Lawrence	AQL
2023	3239.00	Clear Cr.	C	3.50	3.50	Oxygen, Dissolved (W)	Monett WWTP	Barry/Lawrence	AQL
2024 - 2028	0935.00	Clear Fk.	P	25.80	25.80	Oxygen, Dissolved (W)	Knob Noster WWTP	Johnson	AQL
> 10 years	7326.00	Clearwater Lake	L2	1635.00	1635.00	Chlorophyll-a (W)	Rural NPS	Wayne/Reynolds	AQL
> 10 years	7326.00	Clearwater Lake	L2	1635.00	1635.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Wayne/Reynolds	HHP
> 10 years	7326.00	Clearwater Lake	L2	1635.00	1635.00	Phosphorus, Total (W)	Nonpoint Source	Wayne/Reynolds	AQL
2024 - 2028	1706.00	Coldwater Cr.	C	6.90	6.90	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	AQL

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	2177.00	Coonville Cr.	C	1.30	1.30	Lead (W)	Source Unknown	St. Francois	AQL
> 10 years	7378.00	Coot Lake	L3	20.00	20.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	HHP
> 10 years	7379.00	Cottontail Lake	L3	22.00	22.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	HHP
2024 - 2028	1943.00	Courtois Cr.	P	32.00	32.00	Lead (S)	Doe Run Viburnum Division Lead mine	Washington	AQL
2024 - 2028	2382.00	Crane Cr.	P	13.20	13.20	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Stone	AQL
> 10 years	7334.00	Crane Lake	L3	109.00	109.00	Chlorophyll-a (W)	Source Unknown	Iron	AQL
> 10 years	7334.00	Crane Lake	L3	109.00	109.00	Phosphorus, Total (W)	Source Unknown	Iron	AQL
> 10 years	2816.00	Craven Ditch	C	11.60	11.60	Oxygen, Dissolved (W)	Source Unknown	Butler	AQL
2024 - 2028	1703.00	Creve Coeur Cr.	C	3.80	3.80	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	AQL
2024 - 2028	1928.00	Crooked Cr.	P	3.50	3.50	Cadmium (S)	Buick Lead Smelter	Crawford	AQL
2024 - 2028	1928.00	Crooked Cr.	P	3.50	3.50	Cadmium (W)	Buick Lead Smelter	Crawford	AQL
2024 - 2028	1928.00	Crooked Cr.	P	3.50	3.50	Lead (S)	Buick Lead Smelter	Crawford	AQL
2024 - 2028	3961.00	Crooked Creek	C	6.50	6.50	Cadmium (W)	Buick Lead Smelter	Iron/Crawford	AQL
2024 - 2028	3961.00	Crooked Creek	C	6.50	6.50	Copper (W)	Buick Lead Smelter	Iron/Crawford	AQL
> 10 years	7135.00	Crowder St. Park Lake	L3	18.00	18.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Grundy	HHP
> 10 years	2636.00	Current R.	P	124.00	124.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Shannon/Ripley	HHP
> 10 years	2662.00	Current R.	P	18.80	18.80	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Dent/Shannon	HHP
2024 - 2028	0219.00	Dardenne Cr.	P1	7.00	7.00	Oxygen, Dissolved (W)	Source Unknown	St. Charles	AQL
2024 - 2028	0221.00	Dardenne Cr.	P	16.50	16.50	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Charles	WBC B
2024 - 2028	3826.00	Deer Cr.	P	1.60	1.60	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	AQL
2018	3826.00	Deer Cr.	P	1.60	1.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	SCR
2018	3826.00	Deer Cr.	P	1.60	1.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	WBC A
> 10 years	7015.00	Deer Ridge Community Lake	L3	39.00	39.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Lewis	HHP
2024 - 2028	3109.00	Ditch #36	P	7.80	7.80	Oxygen, Dissolved (W)	Source Unknown	Dunklin	AQL
2024 - 2028	3810.00	Douger Br.	C	2.80	2.80	Lead (S)	Aurora Lead Mining District	Lawrence	AQL
2024 - 2028	3810.00	Douger Br.	C	2.80	2.80	Zinc (S)	Aurora Lead Mining District	Lawrence	AQL
2018	1180.00	Dousinbury Cr.	P	3.90	3.90	Escherichia coli (W)	Rural NPS	Dallas	WBC B
2024 - 2028	1792.00	Dry Fk.	C	3.20	3.20	Escherichia coli (W)	Source Unknown	Perry	WBC B
2020	3189.00	Dry Fk.	C	10.20	10.20	Escherichia coli (W)	Rural NPS	Jasper	WBC A
2024 - 2028	3163.00	Dry Hollow	C	0.50	0.50	Escherichia coli (W)	Source Unknown	Lawrence	SCR
2024 - 2028	3569.00	Dutro Carter Cr.	P	1.50	1.50	Oxygen, Dissolved (W)	Rolla SE WWTP	Phelps	AQL

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	3570.00	Dutro Carter Cr.	C	0.50	0.50	Escherichia coli (W)	Source Unknown	Phelps	SCR
2024 - 2028	3570.00	Dutro Carter Cr.	C	0.50	0.50	Escherichia coli (W)	Source Unknown	Phelps	WBC B
2020	3199.00	Duval Cr.	C	7.00	7.00	Escherichia coli (W)	Nonpoint Source	Jasper	WBC B
2023	2166.00	Eaton Br.	C	1.20	1.20	Cadmium (S)	Leadwood tailings pond	St. Francois	AQL
2023	2166.00	Eaton Br.	C	1.20	1.20	Cadmium (W)	Leadwood tailings pond	St. Francois	AQL
2023	2166.00	Eaton Br.	C	1.20	1.20	Lead (S)	Leadwood tailings pond	St. Francois	AQL
2023	2166.00	Eaton Br.	C	1.20	1.20	Lead (W)	Leadwood tailings pond	St. Francois	AQL
2023	2166.00	Eaton Br.	C	1.20	1.20	Zinc (S)	Leadwood tailings pond	St. Francois	AQL
2023	2166.00	Eaton Br.	C	1.20	1.20	Zinc (W)	Leadwood tailings pond	St. Francois	AQL
2024 - 2028	0372.00	E. Fk. Crooked R.	P	19.90	19.90	Oxygen, Dissolved (W)	Source Unknown	Ray	AQL
2019	0457.00	E. Fk. Grand R.	P	28.70	28.70	Escherichia coli (W)	Rural NPS	Worth/Gentry	WBC A
2023	0428.00	E. Fk. L. Blue R.	C	3.70	3.70	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	WBC B
2024 - 2028	0608.00	E. Fk. Locust Cr.	P	16.70	16.70	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	Sullivan	WBC B
2024 - 2028	0608.00	E. Fk. Locust Cr.	P	16.70	16.70	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	Sullivan	SCR
2024 - 2028	0610.00	E. Fk. Locust Cr.	C	15.70	15.70	Escherichia coli (W)	Rural NPS	Sullivan	WBC A
2024 - 2028	0610.00	E. Fk. Locust Cr.	C	15.70	15.70	Oxygen, Dissolved (W)	Rural NPS	Sullivan	AQL
> 10 years	1282.00	E. Fk. Tebo Cr.	C	14.50	14.50	Ammonia, Total (W)	Municipal Point Source Discharges	Henry	AQL
2024 - 2028	1282.00	E. Fk. Tebo Cr.	C	14.50	14.50	Oxygen, Dissolved (W)	Windsor SW WWTP	Henry	AQL
> 10 years	2593.00	Eleven Point R.	P	22.70	22.70	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Oregon	HHP
> 10 years	2597.00	Eleven Point R.	P	11.40	11.40	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Oregon	HHP
> 10 years	2601.00	Eleven Point R.	P	22.30	22.30	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Oregon	HHP
2023	0189.00	Elkhorn Cr.	C	21.40	21.40	Oxygen, Dissolved (W)	Montgomery City East WWTF	Montgomery	AQL
2024 - 2028	1283.00	Elm Br.	C	3.00	3.00	Oxygen, Dissolved (W)	Windsor SE WWTP	Henry	AQL
> 10 years	4110.00	Engelholm Creek	C	3.00	3.00	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	SCR
> 10 years	4110.00	Engelholm Creek	C	3.00	3.00	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
2024 - 2028	1704.00	Fee Fee Cr. (new)	P	1.50	1.50	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	AQL
2018	1704.00	Fee Fee Cr. (new)	P	1.50	1.50	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
2018	1704.00	Fee Fee Cr. (new)	P	1.50	1.50	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	SCR
> 10 years	7237.00	Fellows Lake	L1	800.00	800.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Greene	HHP
2024 - 2028	3595.00	Fenton Cr.	P	0.50	0.50	Chloride (W)	Source Unknown	St. Louis	AQL

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	3595.00	Fenton Cr.	P	0.50	0.50	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
2024 - 2028	2186.00	Fishpot Cr.	P	3.50	3.50	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	AQL
2020	3220.00	Fivemile Cr.	P	5.00	5.00	Escherichia coli (W)	Rural NPS	Newton	WBC B
> 10 years	0864.00	Flat Cr.	P	23.70	23.70	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Pettis/Morgan	HHP
2023	2168.00	Flat River Cr.	C	10.00	10.00	Cadmium (W)	Old Lead Belt tailings	St. Francois	AQL
2023	3938.00	Flat River tributary	US	0.30	0.30	Zinc (W)	Elvins Chat Pile	St. Francois	GEN
> 10 years	7151.00	Forest Lake	L1	580.00	580.00	Chlorophyll-a (W)	Rural NPS	Adair	AQL
> 10 years	7151.00	Forest Lake	L1	580.00	580.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Adair	HHP
> 10 years	7151.00	Forest Lake	L1	580.00	580.00	Nitrogen, Total (W)	Rural NPS	Adair	AQL
> 10 years	7151.00	Forest Lake	L1	580.00	580.00	Phosphorus, Total (W)	Rural NPS	Adair	AQL
2024 - 2028	3943.00	Foster Branch tributary	C	2.00	2.00	Oxygen, Dissolved (W)	Ashland WWTF	Boone	AQL
> 10 years	7324.00	Fourche Lake	L3	49.00	49.00	Chlorophyll-a (W)	Source Unknown	Ripley	AQL
> 10 years	7324.00	Fourche Lake	L3	49.00	49.00	Nitrogen, Total (W)	Source Unknown	Ripley	AQL
2024 - 2028	0747.00	Fowler Cr.	C	6.00	6.00	Oxygen, Dissolved (W)	Source Unknown	Boone	AQL
> 10 years	7382.00	Foxboro Lake	L3	22.00	22.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Franklin	HHP
2023	0038.00	Fox R.	P	42.00	42.00	Escherichia coli (W)	Rural NPS	Clark	WBC B
> 10 years	7008.00	Fox Valley Lake	L3	89.00	89.00	Chlorophyll-a (W)	Rural NPS	Clark	AQL
> 10 years	7008.00	Fox Valley Lake	L3	89.00	89.00	Nitrogen, Total (W)	Rural NPS	Clark	AQL
> 10 years	7008.00	Fox Valley Lake	L3	89.00	89.00	Phosphorus, Total (W)	Rural NPS	Clark	AQL
> 10 years	7280.00	Frisco Lake	L3	5.00	5.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Phelps	HHP
2024 - 2028	4061.00	Gailey Branch	C	3.20	3.20	Oxygen, Dissolved (W)	Source Unknown	Pike	AQL
2024 - 2028	1004.00	Gans Cr.	C	5.50	5.50	Escherichia coli (W)	Rural NPS	Boone	WBC A
> 10 years	1455.00	Gasconade R.	P	264.00	264.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Pulaski	HHP
2024 - 2028	2184.00	Grand Glaize Cr.	C	4.00	4.00	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	AQL
2024 - 2028	2184.00	Grand Glaize Cr.	C	4.00	4.00	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
> 10 years	2184.00	Grand Glaize Cr.	C	4.00	4.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Louis	HHP
2024 - 2028	0593.00	Grand R.	P	56.00	56.00	Escherichia coli (W)	Rural NPS	Livingston/Chariton	WBC A
2024 - 2028	1712.00	Gravois Cr.	P	2.30	2.30	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	AQL
2018	1712.00	Gravois Cr.	P	2.30	2.30	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	WBC B
2024 - 2028	1713.00	Gravois Cr.	C	6.00	6.00	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	AQL
2018	1713.00	Gravois Cr.	C	6.00	6.00	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
> 10 years	4051.00	Gravois Creek tributary	C	1.90	1.90	Escherichia coli (W)	Municipal, Urbanized High Density Area, Urban Runoff/Storm Sewers	St. Louis	WBC B
2024 - 2028	1009.00	Grindstone Cr.	C	2.50	2.50	Escherichia coli (W)	Rural NPS	Boone	WBC A
> 10 years	7386.00	Harrison County Lake	L1	280.00	280.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Harrison	HHP
> 10 years	7152.00	Hazel Creek Lake	L1	453.00	453.00	Chlorophyll-a (W)	Rural NPS	Adair	AQL
> 10 years	7152.00	Hazel Creek Lake	L1	453.00	453.00	Nitrogen, Total (W)	Nonpoint Source	Adair	AQL
> 10 years	2196.00	Headwater Div. Chan.	P	20.30	20.30	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Cape Girardeau	HHP
2024 - 2028	0848.00	Heaths Cr.	P	21.00	21.00	Oxygen, Dissolved (W)	Source Unknown	Pettis/Cooper	AQL
2020	3226.00	Hickory Cr.	P	4.90	4.90	Escherichia coli (W)	Rural NPS	Newton	WBC A
2024 - 2028	1007.00	Hinkson Cr.	P	7.60	7.60	Escherichia coli (W)	Nonpoint Source	Boone	WBC B
2024 - 2028	1008.00	Hinkson Cr.	C	18.80	18.80	Escherichia coli (W)	Nonpoint Source	Boone	WBC A
> 10 years	7193.00	Holden City Lake	L1	290.20	290.20	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Johnson	HHP
2024 - 2028	1011.00	Hominy Br.	C	1.00	1.00	Escherichia coli (W)	Rural NPS	Boone	WBC B
> 10 years	1251.00	Honey Cr.	C	8.50	8.50	Oxygen, Dissolved (W)	Source Unknown	Henry	AQL
2020	3169.00	Honey Cr.	P	16.50	16.50	Escherichia coli (W)	Rural NPS	Lawrence	WBC B
2020	3170.00	Honey Cr.	C	2.70	2.70	Escherichia coli (W)	Rural NPS	Lawrence	WBC B
2024 - 2028	1348.00	Horse Cr.	P	27.70	27.70	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Vernon/Cedar	AQL
2024 - 2028	1348.00	Horse Cr.	P	27.70	27.70	Oxygen, Dissolved (W)	Source Unknown	Vernon/Cedar	AQL
2024 - 2028	3413.00	Horseshoe Cr.	C	5.80	5.80	Oxygen, Dissolved (W)	Source Unknown	Lafayette/Jackson	AQL
> 10 years	7388.00	Hough Park Lake	L3	10.00	10.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Cole	HHP
> 10 years	7029.00	Hunnewell Lake	L3	228.00	228.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Shelby	HHP
2024 - 2028	0420.00	Indian Cr.	C	3.40	3.40	Chloride (W)	Road/Bridge Runoff, Non-construction	Jackson	AQL
2022	0420.00	Indian Cr.	C	3.40	3.40	Escherichia coli (W)	Leawood, KS WWTP	Jackson	WBC A
2024 - 2028	1946.00	Indian Cr.	P	1.90	1.90	Lead (S)	Doe Run Viburnum Division Lead mine	Washington	AQL
2024 - 2028	1946.00	Indian Cr.	P	1.90	1.90	Zinc (S)	Doe Run Viburnum Division Lead mine	Washington	AQL
> 10 years	7389.00	Indian Creek Community Lake	L3	185.00	185.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Livingston	HHP
2024 - 2028	3223.00	Jacobs Br.	P	1.60	1.60	Cadmium (S)	Tri-State Mining District	Newton	AQL
2024 - 2028	3223.00	Jacobs Br.	P	1.60	1.60	Cadmium (W)	Tri-State Mining District	Newton	AQL
2024 - 2028	3223.00	Jacobs Br.	P	1.60	1.60	Lead (S)	Tri-State Mining District	Newton	AQL
2024 - 2028	3223.00	Jacobs Br.	P	1.60	1.60	Zinc (S)	Tri-State Mining District	Newton	AQL

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	3223.00	Jacobs Br.	P	1.60	1.60	Zinc (W)	Tri-State Mining District	Newton	AQL
2020	3207.00	Jenkins Cr.	P	2.80	2.80	Escherichia coli (W)	Rural NPS	Jasper	WBC A
2020	3208.00	Jenkins Cr.	C	4.80	4.80	Escherichia coli (W)	Rural NPS	Newton/Jasper	WBC A
2020	3205.00	Jones Cr.	P	7.50	7.50	Escherichia coli (W)	Rural NPS	Newton/Jasper	WBC A
2021	5006.00	Joplin Creek	C	3.90	3.90	Cadmium (W)	Mill Tailings	Jasper	AQL
2021	5006.00	Joplin Creek	C	3.90	3.90	Zinc (W)	Mill Tailings	Jasper	AQL
> 10 years	3374.00	Jordan Cr.	P	3.80	3.80	Polycyclic Aromatic Hydrocarbons-PAHs (S)	Urban NPS	Greene	AQL
2024 - 2028	3592.00	Keifer Cr.	P	1.20	1.20	Chloride (W)	Road/Bridge Runoff, Non-construction	St. Louis	AQL
2024 - 2028	3592.00	Keifer Cr.	P	1.20	1.20	Escherichia coli (W)	Rural NPS	St. Louis	WBC A
> 10 years	7657.00	Knox Village Lake	L3	3.00	3.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	HHP
2023	2171.00	Koen Cr.	C	1.00	1.00	Lead (S)	Mine Tailings	St. Francois	AQL
> 10 years	7023.00	Labelle Lake #2	L1	98.00	98.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Lewis	HHP
> 10 years	7659.00	Lake Boutin	L3	20.00	20.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Cape Girardeau	HHP
> 10 years	7469.00	Lake Buteo	L3	7.00	7.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Johnson	HHP
> 10 years	7049.00	Lake Lincoln	L3	88.00	88.00	Chlorophyll-a (W)	Source Unknown	Lincoln	AQL
> 10 years	7436.00	Lake of the Woods	L3	3.00	3.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Boone	HHP
> 10 years	7629.00	Lake of the Woods	UL	7.00	7.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	GEN
> 10 years	7132.00	Lake Paho	L3	273.00	273.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Mercer	HHP
> 10 years	7055.00	Lake Ste. Louise	L3	71.00	71.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	St. Charles	HHP
> 10 years	7035.00	Lake Tom Sawyer	L3	4.00	4.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Monroe	HHP
> 10 years	7212.00	Lake Winnebago	L3	272.00	272.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Cass	HHP
2021	0847.00	Lamine R.	P	64.00	64.00	Escherichia coli (W)	Rural NPS	Morgan/Cooper	WBC A
> 10 years	3105.00	Lateral #2 Main Ditch	P	11.50	11.50	Ammonia, Total (W)	Source Unknown	Stoddard	AQL
2024 - 2028	3105.00	Lateral #2 Main Ditch	P	11.50	11.50	Oxygen, Dissolved (W)	Source Unknown	Stoddard	AQL
2024 - 2028	1529.00	L. Beaver Cr.	C	3.50	3.50	Escherichia coli (W)	Source Unknown	Phelps	WBC A
2024 - 2028	1529.00	L. Beaver Cr.	C	3.50	3.50	Sedimentation/Siltation (S)	Smith Sand and Gravel	Phelps	AQL
2023	0422.00	L. Blue R.	P	35.10	35.10	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	WBC B
2023	0422.00	L. Blue R.	P	35.10	35.10	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	SCR
2024 - 2028	1003.00	L. Bonne Femme Cr.	P	9.00	9.00	Escherichia coli (W)	Source Unknown	Boone	WBC B
2024 - 2028	1863.00	L. Dry Fk.	P	5.20	5.20	Oxygen, Dissolved (W)	Rolla SE WWTP	Phelps	AQL
2024 - 2028	1864.00	L. Dry Fk.	C	4.70	4.70	Oxygen, Dissolved (W)	Rolla SE WWTP	Phelps	AQL

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	1864.00	L. Dry Fk.	C	4.70	4.70	Oxygen, Dissolved (W)	Source Unknown	Phelps	AQL
2024 - 2028	1325.00	L. Dry Wood Cr.	P	20.50	20.50	Oxygen, Dissolved (W)	Source Unknown	Vernon	AQL
2024 - 2028	1326.00	L. Dry Wood Cr.	C	15.60	15.60	Oxygen, Dissolved (W)	Source Unknown	Barton/Vernon	AQL
2024 - 2028	3137.00	Lee Rowe Ditch	C	6.00	6.00	Oxygen, Dissolved (W)	Source Unknown	Mississippi	AQL
> 10 years	7346.00	Lewis Lake	L3	6.00	6.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Stoddard	HHP
2024 - 2028	7020.00	Lewistown Lake	L1	35.00	35.00	Atrazine (W)	Rural NPS	Lewis	DWS
2022	3575.00	Line Cr.	C	7.00	7.00	Escherichia coli (W)	Urban Runoff/Storm Sewers	Platte	WBC B
2024 - 2028	4115.00	Little Antire Creek	C	4.00	4.00	Escherichia coli (W)	NPS	Jefferson/St. Louis	WBC B
2023	4107.00	Little Blue River tributary	C	5.50	5.50	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	SCR
2023	4107.00	Little Blue River tributary	C	5.50	5.50	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	WBC B
2021	3279.00	L. Lost Cr.	P	5.80	5.80	Escherichia coli (W)	Rural NPS	Newton	WBC B
2018	0623.00	L. Medicine Cr.	P	39.80	39.80	Escherichia coli (W)	Rural NPS	Mercer/Grundy	WBC B
2024 - 2028	1189.00	L. Niangua R.	P	43.80	43.80	Oxygen, Dissolved (W)	Source Unknown	Dallas/Camden	AQL
2024 - 2028	0606.00	Locust Cr.	P	91.70	91.70	Escherichia coli (W)	Rural NPS	Putnam/Sullivan	SCR
2024 - 2028	0606.00	Locust Cr.	P	91.70	91.70	Escherichia coli (W)	Rural NPS	Putnam/Sullivan	WBC B
2024 - 2028	2763.00	Logan Cr.	P	36.00	36.00	Lead (S)	Sweetwater Lead Mine/Mill	Reynolds	AQL
2024 - 2028	0696.00	Long Branch Cr.	C	14.80	14.80	Oxygen, Dissolved (W)	Atlanta WWTP	Macon	AQL
> 10 years	7097.00	Longview Lake	L2	953.00	953.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	HHP
2024 - 2028	3652.00	L. Osage R.	C	23.60	23.60	Escherichia coli (W)	Rural NPS	Vernon	WBC B
2019	3278.00	Lost Cr.	P	8.50	8.50	Escherichia coli (W)	Rural NPS	Newton	WBC A
2023	2854.00	L. St. Francis R.	P	32.40	32.40	Lead (S)	Catherine Lead Mine, pos. Mine La Motte	Madison	AQL
2024 - 2028	2814.00	Main Ditch	C	13.00	13.00	pH (W)	Poplar Bluff WWTP	Butler	AQL
> 10 years	2814.00	Main Ditch	C	13.00	13.00	Temperature, water (W)	Channelization	Butler	AQL
2018	1709.00	Maline Cr.	C	0.60	0.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	WBC B
2024 - 2028	3839.00	Maline Cr.	C	0.50	0.50	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis City	AQL
2024 - 2028	3839.00	Maline Cr.	C	0.50	0.50	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis City	SCR
> 10 years	7398.00	Maple Leaf Lake	L3	127.00	127.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Lafayette	HHP
> 10 years	7033.00	Mark Twain Lake	L2	18132.00	18132.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Ralls	HHP
> 10 years	4109.00	Martigney Creek	C	1.60	1.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	SCR
> 10 years	4109.00	Martigney Creek	C	1.60	1.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
2024 - 2028	3596.00	Mattese Cr.	P	1.10	1.10	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	1786.00	McClanahan Cr.	C	2.50	2.50	Escherichia coli (W)	Source Unknown	Perry	SCR
2024 - 2028	1786.00	McClanahan Cr.	C	2.50	2.50	Escherichia coli (W)	Source Unknown	Perry	WBC B
2018	0619.00	Medicine Cr.	P	43.80	43.80	Escherichia coli (W)	Rural NPS	Putnam/Grundy	WBC B
> 10 years	2183.00	Meramec R.	P	22.80	22.80	Escherichia coli (W)	Source Unknown	St. Louis	WBC A
2024 - 2028	2183.00	Meramec R.	P	22.80	22.80	Lead (S)	Old Lead belt tailings	St. Louis	AQL
2024 - 2028	0123.00	M. Fk. Salt R.	C	25.40	25.40	Oxygen, Dissolved (W)	Macon WWTP	Macon	AQL
2024 - 2028	1299.00	Miami Cr.	P	19.60	19.60	Oxygen, Dissolved (W)	Source Unknown	Bates	AQL
2021	0468.00	Middle Fk. Grand R.	P	27.50	27.50	Escherichia coli (W)	Rural NPS	Worth/Gentry	WBC A
2024 - 2028	3262.00	Middle Indian Cr.	C	3.50	3.50	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Newton	AQL
2024 - 2028	3263.00	Middle Indian Cr.	P	2.20	2.20	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Newton	AQL
2019	3263.00	Middle Indian Cr.	P	2.20	2.20	Escherichia coli (W)	Rural NPS	Newton	WBC B
2023	4066.00	Mill Creek	C	3.40	3.40	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	SCR
2023	4066.00	Mill Creek	C	3.40	3.40	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	WBC B
2024 - 2028	4066.00	Mill Creek	C	3.40	3.40	Oxygen, Dissolved (W)	Urban Runoff/Storm Sewers	Jackson	AQL
> 10 years	1707.03	Mississippi R.	P	44.60	44.60	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	St. Louis/Ste. Genevieve	WBC B
> 10 years	0226.00	Missouri R.	P	184.50	184.50	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	Atchison/Jackson	WBC B
> 10 years	0356.00	Missouri R.	P	129.00	129.00	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	Jackson/Chariton	SCR
> 10 years	0356.00	Missouri R.	P	129.00	129.00	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	Jackson/Chariton	WBC B
> 10 years	1604.00	Missouri R.	P	104.50	104.50	Escherichia coli (W)	Municipal Point Source Discharges, Nonpoint Source	St. Charles/St. Louis	WBC B
> 10 years	7031.00	Monroe City Lake	L1	94.00	94.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Ralls	HHP
> 10 years	7301.00	Monsanto Lake	L3	18.00	18.00	Chlorophyll-a (W)	Source Unknown	St. Francois	AQL
> 10 years	7301.00	Monsanto Lake	L3	18.00	18.00	Nitrogen, Total (W)	Source Unknown	St. Francois	AQL
> 10 years	7301.00	Monsanto Lake	L3	18.00	18.00	Phosphorus, Total (W)	Source Unknown	St. Francois	AQL
> 10 years	7402.00	Mozingo Lake	L1	898.00	898.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Nodaway	HHP
2024 - 2028	0853.00	Muddy Cr.	P	62.20	62.20	Escherichia coli (W)	Rural NPS	Pettis	WBC B
2019	0158.00	N. Fk. Cuivre R.	P	25.10	25.10	Escherichia coli (W)	Rural NPS	Pike/Lincoln	WBC A
> 10 years	0110.00	N. Fk. Salt R.	P	84.90	84.90	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Shelby/Monroe	HHP
2020	3186.00	N. Fk. Spring R.	P	17.40	17.40	Escherichia coli (W)	Rural NPS	Jasper	WBC B
2020	3188.00	N. Fk. Spring R.	C	55.90	55.90	Escherichia coli (W)	Rural NPS	Dade/Jasper	WBC B

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	3188.00	N. Fk. Spring R.	C	55.90	55.90	Oxygen, Dissolved (W)	Source Unknown	Dade/Jasper	AQL
2018	1170.00	Niangua R.	P	56.00	56.00	Escherichia coli (W)	Rural NPS	Webster/Dallas	WBC A
2024 - 2028	3260.00	N. Indian Cr.	P	5.20	5.20	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Newton	AQL
2020	3260.00	N. Indian Cr.	P	5.20	5.20	Escherichia coli (W)	Rural NPS	Newton	WBC B
2024 - 2028	0227.00	Nishnabotna R.	P	10.20	10.20	Escherichia coli (W)	Rural NPS	Atchison	WBC B
2024 - 2028	0227.00	Nishnabotna R.	P	10.20	10.20	Escherichia coli (W)	Rural NPS	Atchison	SCR
> 10 years	7316.00	Noblett Lake	L3	26.00	26.00	Chlorophyll-a (W)	Nonpoint Source	Douglas	AQL
> 10 years	7316.00	Noblett Lake	L3	26.00	26.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Douglas	HHP
> 10 years	7316.00	Noblett Lake	L3	26.00	26.00	Phosphorus, Total (W)	Nonpoint Source	Douglas	AQL
2024 - 2028	0550.00	No Cr.	P	28.70	28.70	Escherichia coli (W)	Rural NPS	Grundy/Livingston	WBC B
2024 - 2028	0550.00	No Cr.	P	28.70	28.70	Escherichia coli (W)	Source Unknown	Grundy/Livingston	SCR
2024 - 2028	0550.00	No Cr.	P	28.70	28.70	Oxygen, Dissolved (W)	Source Unknown	Grundy/Livingston	AQL
2019	0279.00	Nodaway R.	P	59.30	59.30	Escherichia coli (W)	Rural NPS	Nodaway/Andrew	WBC B
> 10 years	7317.00	Norfork Lake	L2	1000.00	1000.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Ozark	HHP
> 10 years	7109.00	North Bethany City Reservoir	L3	78.00	78.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Harrison	HHP
2024 - 2028	3811.00	North Branch Wilsons Cr.	P	3.80	3.80	Zinc (S)	Urban NPS	Greene	AQL
2024 - 2028	1794.00	Omete Cr.	C	1.20	1.20	Escherichia coli (W)	Source Unknown	Perry	SCR
2024 - 2028	1794.00	Omete Cr.	C	1.20	1.20	Escherichia coli (W)	Source Unknown	Perry	WBC B
2020	3190.00	Opossum Cr.	C	6.40	6.40	Escherichia coli (W)	Rural NPS	Jasper	WBC B
2019	1293.00	Osage R.	P	50.70	50.70	Escherichia coli (W)	Source Unknown	Vernon/St. Clair	WBC A
2024 - 2028	1293.00	Osage R.	P	50.70	50.70	Oxygen, Dissolved (W)	Source Unknown	Vernon/St. Clair	AQL
2024 - 2028	1373.00	Panther Cr.	C	9.70	9.70	Oxygen, Dissolved (W)	Source Unknown	Polk/St. Clair	AQL
2024 - 2028	2373.00	Pearson Cr.	P	8.00	8.00	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	Greene	AQL
2024 - 2028	2373.00	Pearson Cr.	P	8.00	8.00	Escherichia coli (W)	Rural NPS	Greene	WBC A
2024 - 2028	0099.00	Peno Cr.	C	14.40	14.40	Oxygen, Dissolved (W)	Northeast Correctional Center WWTP	Pike	AQL
> 10 years	7273.00	Perry County Community Lake	L3	89.00	89.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Perry	HHP
> 10 years	7628.00	Perry Phillips Lake	UL	32.00	32.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Boone	GEN
2024 - 2028	0215.00	Peruque Cr.	P1	9.60	9.60	Oxygen, Dissolved (W)	Source Unknown	St. Charles	AQL
2024 - 2028	0218.00	Peruque Cr.	C	10.90	10.90	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Nonpoint Source	Warren/St. Charles	AQL
2024 - 2028	0218.00	Peruque Cr.	C	10.90	10.90	Oxygen, Dissolved (W)	Source Unknown	Warren/St. Charles	AQL
> 10 years	0785.00	Petite Saline Cr.	P	21.00	21.00	Oxygen, Dissolved (W)	Source Unknown	Cooper/Moniteau	AQL
2024 - 2028	2815.00	Pike Cr.	C	6.00	6.00	Oxygen, Dissolved (W)	Source Unknown	Butler	AQL
2019	0312.00	Platte R.	P	142.40	142.40	Escherichia coli (W)	Rural NPS	Worth/Platte	WBC B
2024 - 2028	1327.00	Pleasant Run Cr.	C	7.60	7.60	Oxygen, Dissolved (W)	Source Unknown	Vernon	AQL
2024 - 2028	3120.00	Pole Cat Slough	P	12.60	12.60	Oxygen, Dissolved (W)	Source Unknown	Dunklin	AQL
2024 - 2028	3120.00	Pole Cat Slough	P	12.60	12.60	Temperature, water (W)	Source Unknown	Dunklin	AQL
2019	1440.00	Pomme de Terre R.	P	69.10	69.10	Escherichia coli (W)	Rural NPS	Webster/Polk	WBC A

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	2038.00	Red Oak Cr.	C	10.00	10.00	Oxygen, Dissolved (W)	Owensville WWTP	Gasconade	AQL
> 10 years	0743.00	Renfro Cr.	C	1.50	1.50	Oxygen, Dissolved (W)	Abandoned Mine Lands and Rural NPS	Callaway/Boone	AQL
> 10 years	7204.00	Rinquelin Trail Community Lake	L3	27.00	27.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Maries	HHP
2024 - 2028	1710.00	River des Peres	P	2.60	2.60	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis City	AQL
2024 - 2028	1710.00	River des Peres	P	2.60	2.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis City	SCR
2024 - 2028	3972.00	River des Peres	C	13.60	13.60	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	AQL
2024 - 2028	3972.00	River des Peres	C	13.60	13.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	SCR
2024 - 2028	3972.00	River des Peres	C	13.60	13.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
> 10 years	4111.00	River des Peres tributary	C	1.80	1.80	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis	AQL
2024 - 2028	4111.00	River des Peres tributary	C	1.80	1.80	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	SCR
2024 - 2028	4111.00	River des Peres tributary	C	1.80	1.80	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
2022	4106.00	Rock Creek	C	6.20	6.20	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson/Clay	SCR
2022	4106.00	Rock Creek	C	6.20	6.20	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson/Clay	WBC B
> 10 years	3577.00	Sadler Br.	C	0.80	0.80	Oxygen, Dissolved (W)	Source Unknown	Polk	AQL
2024 - 2028	0594.00	Salt Cr.	C	14.90	14.90	Oxygen, Dissolved (W)	Source Unknown	Chariton	AQL
2024 - 2028	0893.00	Salt Fk.	P	26.70	26.70	Oxygen, Dissolved (W)	Source Unknown	Saline	AQL
2024 - 2028	2113.00	Salt Pine Cr.	C	1.20	1.20	Lead (S)	Barite tailings pond	Washington	AQL
2024 - 2028	2113.00	Salt Pine Cr.	C	1.20	1.20	Zinc (S)	Barite tailings pond	Washington	AQL
> 10 years	0091.00	Salt R.	P	29.00	29.00	Oxygen, Dissolved (W)	Mark Twain Lake re-regulation dam	Ralls/Pike	AQL
> 10 years	0103.00	Salt R.	P1	9.30	9.30	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Ralls	HHP
> 10 years	0103.00	Salt R.	P1	9.30	9.30	Oxygen, Dissolved (W)	Cannon Dam	Ralls	AQL
2024 - 2028	0655.00	S. Blackbird Cr.	C	13.00	13.00	Ammonia, Total (W)	Source Unknown	Putnam	AQL
2024 - 2028	0142.00	S. Fk. Salt R.	C	40.10	40.10	Oxygen, Dissolved (W)	Mexico WWTP, Rural Nonpoint Source	Callaway/Audrain	AQL
2019	1249.00	S. Grand R.	P	66.80	66.80	Escherichia coli (W)	Rural NPS	Cass/Henry	WBC B
2024 - 2028	3222.00	Shoal Cr.	P	50.50	50.50	Zinc (S)	Mill Tailings	Newton	AQL
2024 - 2028	3244.00	Silver Cr.	P	1.90	1.90	Zinc (S)	Mill Tailings	Newton	AQL
2024 - 2028	3259.00	S. Indian Cr.	P	8.70	8.70	Aquatic Macroinvertebrate Bioassessments/ Unknown (W)	Source Unknown	McDonald/Newton	AQL
2020	3259.00	S. Indian Cr.	P	8.70	8.70	Escherichia coli (W)	Rural NPS	McDonald/Newton	WBC B
2020	3754.00	Slater Br.	C	3.70	3.70	Escherichia coli (W)	Nonpoint Source	Jasper	WBC B
2024 - 2028	0399.00	Sni-a-bar Cr.	P	36.60	36.60	Oxygen, Dissolved (W)	Source Unknown	Jackson/Lafayette	AQL

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	0224.00	Spencer Cr.	C	1.50	1.50	Chloride (W)	Road/Bridge Runoff, Non-construction	St. Charles	AQL
2023	5004.00	Spring Branch	C	6.70	6.70	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	SCR
2023	5004.00	Spring Branch	C	6.70	6.70	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jackson	WBC B
2024 - 2028	5007.00	Spring Branch	C	3.10	3.10	Escherichia coli (W)	Source Unknown	St. Louis	WBC B
2020	3160.00	Spring R.	P	61.70	61.70	Escherichia coli (W)	Rural NPS	Lawrence/Jasper	WBC A
2020	3164.00	Spring R.	P	8.80	8.80	Escherichia coli (W)	Rural NPS	Lawrence	WBC A
2020	3165.00	Spring R.	P	11.90	11.90	Escherichia coli (W)	Rural NPS	Lawrence	WBC A
2020	4112.00	Spring River tributary	C	4.00	4.00	Escherichia coli (W)	Nonpoint Source	Jasper	WBC B
> 10 years	2677.00	Spring Valley Cr.	P	10.80	10.80	Oxygen, Dissolved (W)	Source Unknown	Shannon	AQL
2024 - 2028	3135.00	Stevenson Bayou	C	6.40	6.40	Oxygen, Dissolved (W)	Source Unknown	Mississippi	AQL
2024 - 2028	2835.00	St. Francis R.	P	93.10	93.10	Temperature, water (W)	Source Unknown	St. Francois	CLF
> 10 years	3138.00	St. Johns Ditch	P	15.30	15.30	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	New Madrid	HHP
2024 - 2028	0959.00	Straight Fk.	C	6.00	6.00	Oxygen, Dissolved (W)	Versailles WWTP	Morgan	AQL
2024 - 2028	0686.00	Sugar Cr.	P	6.80	6.80	Oxygen, Dissolved (W)	Source Unknown	Randolph	AQL
> 10 years	0686.00	Sugar Cr.	P	6.80	6.80	Sulfate + Chloride (W)	Source Unknown	Randolph	AQL
2024 - 2028	4108.00	Sugar Creek	C	1.80	1.80	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	SCR
2024 - 2028	4108.00	Sugar Creek	C	1.80	1.80	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
2024 - 2028	4117.00	Sugar Creek	C	3.60	3.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	SCR
2024 - 2028	4117.00	Sugar Creek	C	3.60	3.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
> 10 years	7166.00	Sugar Creek Lake	L1	308.00	308.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Randolph	HHP
> 10 years	7399.00	Sunset Lake	L3	6.00	6.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Cole	HHP
2024 - 2028	7313.00	Table Rock Lake	L2	41747.00	41747.00	Chlorophyll-a (W)	Municipal Point Source Discharges, Nonpoint Source	Stone	AQL
2024 - 2028	7313.00	Table Rock Lake	L2	41747.00	41747.00	Nitrogen, Total (W)	Municipal Point Source Discharges, Nonpoint Source	Stone	AQL
2024 - 2028	7313.00	Table Rock Lake	L2	41747.00	41747.00	Nutrient/Eutrophication Biol. Indicators (W)	Municipal Point Source Discharges, Nonpoint Source	Stone	AQL
> 10 years	7352.00	Thirtyfour Corner Blue Hole	L3	9.00	9.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Mississippi	HHP
2018	0549.00	Thompson R.	P	70.60	70.60	Escherichia coli (W)	Rural NPS	Harrison	WBC B
2020	3243.00	Thurman Cr.	P	3.00	3.00	Escherichia coli (W)	Rural NPS	Newton	WBC B
2024 - 2028	2114.00	Trib. Old Mines Cr.	C	1.50	1.50	Lead (S)	Barite tailings pond	Washington	AQL
2024 - 2028	2114.00	Trib. Old Mines Cr.	C	1.50	1.50	Sedimentation/Siltation (S)	Barite tailings pond	Washington	AQL
2024 - 2028	2114.00	Trib. Old Mines Cr.	C	1.50	1.50	Zinc (S)	Barite tailings pond	Washington	AQL

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2019	1420.00	Trib. to Goose Cr.	C	3.00	3.00	Escherichia coli (W)	Rural NPS	Lawrence	WBC B
> 10 years	3490.00	Trib. to L. Muddy Cr.	C	1.00	1.00	Chloride (W)	Tyson Foods	Pettis	AQL
2024 - 2028	3981.00	Trib. to Shoal Cr.	US	1.56	1.56	Cadmium (W)	Tanyard Hollow Pits	Jasper/Newton	GEN
2024 - 2028	3981.00	Trib. to Shoal Cr.	US	1.56	1.56	Zinc (W)	Tanyard Hollow Pits	Jasper/Newton	GEN
2024 - 2028	3982.00	Trib. to Shoal Cr.	US	2.20	2.20	Zinc (W)	Maiden Lane Pits	Jasper/Newton	GEN
2021	3983.00	Trib. to Turkey Cr.	US	2.90	2.90	Cadmium (S)	Abandoned Smelter Site	Jasper	GEN
2021	3983.00	Trib. to Turkey Cr.	US	2.90	2.90	Cadmium (W)	Abandoned Smelter Site	Jasper	GEN
2021	3983.00	Trib. to Turkey Cr.	US	2.90	2.90	Lead (S)	Abandoned Smelter Site	Jasper	GEN
2021	3983.00	Trib. to Turkey Cr.	US	2.90	2.90	Zinc (S)	Abandoned Smelter Site	Jasper	GEN
2021	3983.00	Trib. to Turkey Cr.	US	2.90	2.90	Zinc (W)	Abandoned Smelter Site	Jasper	GEN
2021	3984.00	Trib. to Turkey Cr.	US	2.20	2.20	Cadmium (W)	Mill Tailings	Jasper	GEN
2021	3984.00	Trib. to Turkey Cr.	US	2.20	2.20	Zinc (W)	Leadwood Hollow pits	Jasper	GEN
2021	3985.00	Trib. to Turkey Cr.	US	1.60	1.60	Zinc (W)	Chitwood Hollow pits	Jasper	GEN
2024 - 2028	0956.00	Trib. to Willow Fk.	C	0.50	0.50	Oxygen, Dissolved (W)	Source Unknown	Moniteau	AQL
2024 - 2028	3589.00	Trib. to Wolf Cr.	C	1.50	1.50	Oxygen, Dissolved (W)	Source Unknown	St. Francois	AQL
2024 - 2028	0074.00	Troublesome Cr.	C	41.30	41.30	Oxygen, Dissolved (W)	Source Unknown	Knox	AQL
> 10 years	0074.00	Troublesome Cr.	C	41.30	41.30	Sedimentation/Siltation (S)	Habitat Mod. - other than Hydromod.	Knox/Marion	AQL
2020	3174.00	Truitt Cr.	P	1.50	1.50	Escherichia coli (W)	Rural NPS	Lawrence	WBC B
2020	3175.00	Truitt Cr.	C	6.40	6.40	Escherichia coli (W)	Rural NPS	Lawrence	SCR
2022	0751.00	Turkey Cr.	C	6.30	6.30	Escherichia coli (W)	Source Unknown	Boone	WBC A
> 10 years	2985.00	Turkey Cr.	C	3.10	3.10	Ammonia, Total (W)	Puxico WWTF	Stoddard	AQL
> 10 years	2985.00	Turkey Cr.	C	3.10	3.10	Oxygen, Dissolved (W)	Puxico WWTF	Stoddard	AQL
2021	3216.00	Turkey Cr.	P	7.70	7.70	Cadmium (S)	Tri-State Mining District	Jasper	AQL
2021	3216.00	Turkey Cr.	P	7.70	7.70	Cadmium (W)	Tri-State Mining District	Jasper	AQL
2020	3216.00	Turkey Cr.	P	7.70	7.70	Escherichia coli (W)	Nonpoint Source	Jasper	WBC B
2021	3216.00	Turkey Cr.	P	7.70	7.70	Lead (S)	Tri-State Mining District	Jasper	AQL
2021	3216.00	Turkey Cr.	P	7.70	7.70	Zinc (S)	Tri-State Mining District	Jasper	AQL
2021	3217.00	Turkey Cr.	P	6.10	6.10	Cadmium (S)	Tri-State Mining District	Jasper	AQL
2020	3217.00	Turkey Cr.	P	6.10	6.10	Escherichia coli (W)	Urban Runoff/Storm Sewers	Jasper	WBC A
2021	3217.00	Turkey Cr.	P	6.10	6.10	Lead (S)	Tri-State Mining District	Jasper	AQL
2021	3217.00	Turkey Cr.	P	6.10	6.10	Zinc (S)	Tri-State Mining District	Jasper	AQL
2024 - 2028	3282.00	Turkey Cr.	P	2.40	2.40	Cadmium (S)	Bonne Terre chat pile	St. Francois	AQL
2024 - 2028	3282.00	Turkey Cr.	P	2.40	2.40	Cadmium (W)	Bonne Terre chat pile	St. Francois	AQL
2024 - 2028	3282.00	Turkey Cr.	P	2.40	2.40	Copper (S)	Bonne Terre chat pile	St. Francois	AQL
2024 - 2028	3282.00	Turkey Cr.	P	2.40	2.40	Lead (S)	Bonne Terre chat pile	St. Francois	AQL
2024 - 2028	3282.00	Turkey Cr.	P	2.40	2.40	Lead (W)	Bonne Terre chat pile	St. Francois	AQL
2024 - 2028	3282.00	Turkey Cr.	P	2.40	2.40	Nickel (S)	Bonne Terre chat pile	St. Francois	AQL

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impaired Use
2024 - 2028	3282.00	Turkey Cr.	P	2.40	2.40	Zinc (S)	Bonne Terre chat pile	St. Francois	AQL
2024 - 2028	3282.00	Turkey Cr.	P	2.40	2.40	Zinc (W)	Bonne Terre chat pile	St. Francois	AQL
2020	1414.00	Turnback Cr.	P	19.90	19.90	Escherichia coli (W)	Rural NPS	Lawrence/Dade	WBC A
2024 - 2028	4079.00	Twomile Creek	C	5.60	5.60	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
> 10 years	7099.00	Unity Village Lake #2	L1	26.00	26.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Jackson	HHP
2024 - 2028	1708.00	Watkins Cr.	C	1.40	1.40	Chloride (W)	Urban Runoff/Storm Sewers	St. Louis/St. Louis City	AQL
> 10 years	4097.00	Watkins Creek tributary	C	1.20	1.20	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	SCR
> 10 years	4097.00	Watkins Creek tributary	C	1.20	1.20	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
> 10 years	4098.00	Watkins Creek tributary	C	1.20	1.20	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	SCR
> 10 years	4098.00	Watkins Creek tributary	C	1.20	1.20	Escherichia coli (W)	Urban Runoff/Storm Sewers	St. Louis	WBC B
> 10 years	7071.00	Weatherby Lake	L3	185.00	185.00	Chlorophyll-a (W)	Urban Runoff/Storm Sewers	Platte	AQL
> 10 years	7071.00	Weatherby Lake	L3	185.00	185.00	Mercury in Fish Tissue (T)	Atmospheric Deposition - Toxics	Platte	HHP
> 10 years	7071.00	Weatherby Lake	L3	185.00	185.00	Nitrogen, Total (W)	Urban Runoff/Storm Sewers	Platte	AQL
> 10 years	7071.00	Weatherby Lake	L3	185.00	185.00	Phosphorus, Total (W)	Urban Runoff/Storm Sewers	Platte	AQL
2019	0560.00	Weldon R.	P	43.40	43.40	Escherichia coli (W)	Rural NPS	Mercer/Grundy	WBC B
2024 - 2028	2755.00	W. Fk. Black R.	P	32.30	32.30	Lead (S)	West Fork Lead Mine/Mill	Reynolds	AQL
2024 - 2028	2755.00	W. Fk. Black R.	P	32.30	32.30	Nickel (S)	West Fork Lead Mine/Mill	Reynolds	AQL
2024 - 2028	2755.00	W. Fk. Black R.	P	32.30	32.30	Zinc (W)	West Fork Lead Mine/Mill	Reynolds	AQL
2024 - 2028	1317.00	W. Fk. Dry Wood Cr.	C	8.10	8.10	Oxygen, Dissolved (W)	Source Unknown	Vernon	AQL
2023	1504.00	Whetstone Cr.	P	12.20	12.20	Oxygen, Dissolved (W)	Rural NPS	Wright	AQL
2020	3182.00	White Oak Cr.	C	18.00	18.00	Escherichia coli (W)	Rural NPS	Lawrence/Jasper	WBC A
2024 - 2028	1700.00	Wildhorse Cr.	C	3.90	3.90	Escherichia coli (W)	Rural, Residential Areas	St. Louis	WBC B
2020	3171.00	Williams Cr.	P	1.00	1.00	Escherichia coli (W)	Rural NPS	Lawrence	WBC A
2020	3172.00	Williams Cr.	P	8.50	8.50	Escherichia coli (W)	Rural NPS	Lawrence	WBC A
2024 - 2028	3594.00	Williams Cr.	P	1.00	1.00	Escherichia coli (W)	Rural NPS	St. Louis	WBC B
2024 - 2028	3594.00	Williams Cr.	P	1.00	1.00	Escherichia coli (W)	Rural NPS	St. Louis	SCR
2024 - 2028	3280.00	Willow Br.	P	2.20	2.20	Cadmium (S)	Mill Tailings	Newton	AQL
2020	3280.00	Willow Br.	P	2.20	2.20	Escherichia coli (W)	Rural NPS	Newton	WBC B
2024 - 2028	3280.00	Willow Br.	P	2.20	2.20	Zinc (S)	Mill Tailings	Newton	AQL
2024 - 2028	0955.00	Willow Fk.	C	6.80	6.80	Oxygen, Dissolved (W)	Tipton WWTP	Moniteau	AQL
2024 - 2028	2375.00	Wilsons Cr.	P	14.00	14.00	Escherichia coli (W)	Nonpoint Source	Greene/Christian	WBC B

TMDL Schedule	WBID	Waterbody	Class	Impaired Segment Size (mi/acres)	Classified Segment Size (mi/acres)	Pollutant	Source	County	Impared Use
> 10 years	2375.00	Wilsons Cr.	P	14.00	14.00	Polycyclic Aromatic Hydrocarbons- PAHs (S)	Nonpoint Source	Greene	AQL
2024 - 2028	2429.00	Woods Fk.	C	5.50	5.50	Fishes Bioassessments/ Unknown (W)	Source Unknown	Christian	AQL

Appendix D

Lake-specific nutrient data and trophic status

Lake name	Acres	County	Years of data	ChlT (µg/L)	Secchi depth (m)	TN (µg/L)	TP (µg/L)	overall TS	NVSS (mg/L)	VSS (mg/L)
<u>Glaciated Plains</u>										
Baring Country Club Lake	81	Knox	9	20.2	1.24	939	28	Eutrophic	3.0	4.2
Belcher Branch Lake	42	Buchanan	7	15.1	1.09	580	37	Eutrophic	3.7	2.6
Bilby Ranch Lake	95	Nodaway	15	35.6	1.02	908	50	Eutrophic	2.9	5.2
Blind Pony Lake	96	Saline	19	45.9	0.59	1320	92	Eutrophic	6.8	5.9
Bowling Green Lake nr Dam	41	Pike	27	7.6	1.66	496	23	Mesotrophic	1.6	1.8
Bowling Green Lake Old nr Dam	7	Pike	12	15.6	0.89	980	100	Eutrophic	2.5	3.0
Breckenridge Lake nr. dam	13	Caldwell	4	33.2	1.14	754	55	Eutrophic	2.5	4.2
Brookfield Lake	120	Linn	24	8.0	1.25	608	22	Mesotrophic	3.7	2.1
Bucklin Lake Intake - PDW	17	Linn	3	39.2	0.54	2231	133	Eutrophic	7.7	7.3
Cameron Lake #3 deep site	92	DeKalb	13	32.4	0.49	1052	121	Eutrophic	13.6	5.2
Cameron Lake #4 nr. dam	173	DeKalb	12	38.1	0.54	2026	158	Eutrophic	11.7	5.7
Charity Lake	9	Atchison	3	19.0	1.54	619	39	Eutrophic	1.3	2.8
Concordia Lake nr. dam	272.5	Lafayette	11	34.4	0.64	1037	72	Eutrophic	7.0	4.3
Crystal Lake nr Dam	122	Ray	4	33.6	0.61	973	81	Eutrophic	10.9	6.2
Deer Ridge Comm. Lake	39	Lewis	24	19.5	1.29	802	43	Eutrophic	3.2	3.9
Edina Reservoir nr. dam	51	Knox	12	33.7	0.65	1289	72	Eutrophic	8.2	4.8
Ella Ewing Lake	15	Scotland	10	37.4	0.65	1341	87	Eutrophic	8.1	4.3
Elmwood Lake nr. PDW Milan Intake	197	Sullivan	12	20.7	0.78	784	59	Eutrophic	5.7	3.3
Forest Lake nr Dam	580	Adair	23	6.5	1.21	450	28	Mesotrophic	4.5	1.7
Fountain Grove - Jo Shelby Lake	NA	Linn	4	43.8	0.86	1121	69	Eutrophic	2.2	6.3
Fox Valley Lake	89	Clark	15	12.7	1.92	659	25	Mesotrophic	1.6	2.5
Green City Lake nr. Dam	57	Sullivan	9	34.0	0.59	1140	81	Eutrophic	6.4	6.1
Hamilton Lake nr Dam	80	Caldwell	13	16.3	0.83	975	59	Eutrophic	6.0	3.5
Happy Holler Lake	67	Andrew	3	60.7	0.87	1049	73	Eutrophic	4.5	6.2
Harrison County Lake Intake - PDW	280	Harrison	15	46.9	0.67	1130	79	Eutrophic	7.4	6.2
Hazel Creek Lk. nr Dam	453	Adair	19	13.1	1.17	632	29	Eutrophic	3.9	2.6
Henry Sever Lake	158	Knox	24	18.3	0.86	1040	56	Eutrophic	4.1	3.3
Higginsville South Lake	147.1	Lafayette	24	36.9	0.62	1304	105	Eutrophic	10.4	5.0
Hunnewell Lake	228	Shelby	25	26.6	1.00	850	45	Eutrophic	3.2	4.4
Indian Creek Lake	185	Livingston	6	18.6	1.59	670	26	Eutrophic	1.5	3.7
Jacomo Lake nr Dam	998	Jackson	21	18.9	1.23	511	37	Eutrophic	2.2	3.3
Jamesport City Lake nr. dam	16	Daviess	4	68.6	0.73	1413	113	Hypereutrophic	3.4	9.1
Jamesport Community Lake	27	Daviess	3	133.8	0.45	1918	139	Hypereutrophic	3.3	15.1

King City New Reservoir Intake - PDW	25.4	Gentry	4	36.6	0.67	1067	97	Eutrophic	7.2	6.2
King Lake	204	DeKalb	7	24.5	0.22	1670	209	Hypereutrophic	36.2	7.6
Kraut Run Busch Area 33	164	St. Charles	25	73.7	0.48	1168	103	Hypereutrophic	6.5	9.7
L. Ste. Louise nr Dam	71	St. Charles	14	10.4	1.11	516	33	Eutrophic	3.9	2.2
La Plata Lake - New nr. dam	81	Macon	7	18.4	1.11	839	31	Eutrophic	3.6	3.7
LaBelle Lake #2 nr Dam	98	Lewis	10	58.1	0.81	1297	91	Eutrophic	2.3	8.0
Lake 37, Busch CA	NA	St. Charles	3	8.1	1.23	488	29	Mesotrophic	3.4	2.0
Lake Allaman nr. dam	6	Clinton	8	15.7	1.24	637	41	Eutrophic	3.8	3.9
Lake Contrary	291	Buchanan	5	241.4	0.23	3409	402	Hypereutrophic	19.3	37.6
Lake Marie	273	Mercer	10	4.1	2.83	446	15	Mesotrophic	2.0	1.5
Lake Nehai Tonkayea	228	Chariton	11	2.7	1.96	401	16	Mesotrophic	2.8	1.1
Lake Paho	273	Mercer	12	14.5	0.82	829	47	Eutrophic	6.8	3.0
Lake Showme nr. dam	214	Scotland	3	31.0	1.17	953	41	Eutrophic	1.7	5.8
Lake St. Louis near dam	444	St. Charles	19	29.2	0.59	1035	72	Eutrophic	13.6	4.8
Lake Tapawingo	83	Jackson	15	30.9	1.06	707	39	Eutrophic	2.2	5.1
Lake Thunderhead	859	Putnam	12	17.9	0.76	971	50	Eutrophic	8.4	2.9
Lake Viking @ dam	552	Daviess	25	9.4	1.46	508	26	Eutrophic	3.5	1.9
Lakewood Lake	279	Jackson	5	18.2	1.25	593	35	Eutrophic	3.2	3.0
Lancaster City Lake - New nr. dam	56	Schuyler	8	37.6	0.72	966	74	Eutrophic	3.8	6.1
Lawson City Lake nr. dam	25	Ray	4	28.2	0.89	935	35	Eutrophic	4.3	5.4
Limpp Lake	27	Gentry	3	84.5	0.38	1684	118	Hypereutrophic	14.1	18.2
Lincoln Lake	88	Lincoln	26	5.0	2.28	406	16	Mesotrophic	1.8	1.6
Long Branch L. nr Dam	2686	Macon	26	14.7	1.23	905	50	Eutrophic	6.6	2.9
Longview L. nr. Dam	953	Jackson	26	10.8	1.02	642	29	Eutrophic	5.3	2.4
Lotawana Lk. Nr Dam	487	Jackson	16	16.8	1.47	560	36	Eutrophic	1.8	2.4
Macon City Lake	189	Macon	13	29.8	0.84	880	52	Eutrophic	5.4	4.4
Maple Leaf Lake	127	Lafayette	10	22.4	1.08	821	39	Eutrophic	3.0	3.5
Marceline (Old) City Lake	68	Linn	6	37.6	0.89	1340	130	Eutrophic	8.8	6.3
Marceline City Lake New nr. Dam	200	Chariton	14	42.0	0.77	1138	89	Eutrophic	5.1	6.7
Mark Twain Lake nr Dam	18132	Ralls	25	18.7	1.05	1320	65	Eutrophic	3.8	2.8
Maysville Lake #1 Intake - PDW	27	DeKalb	12	47.7	0.65	1291	177	Hypereutrophic	5.4	6.7
Memphis Lake No.1	39	Scotland	13	53.4	0.57	1276	81	Eutrophic	7.8	9.6
Milan Lake (New)	37	Sullivan	13	14.9	1.06	703	45	Eutrophic	5.0	3.2
Monroe City Lake B nr. dam	55	Monroe	14	40.0	0.52	1218	84	Eutrophic	8.1	6.2
Monroe City Lake nr. dam	94	Ralls	3	49.0	0.58	1349	116	Hypereutrophic	5.3	6.9
Mozingo Lake nr dam	898	Nodaway	15	19.7	1.43	824	32	Eutrophic	2.2	2.5
Nodaway Lake	73	Nodaway	15	28.1	0.80	1027	47	Eutrophic	5.0	5.1
North Bethany City Reservoir	78	Harrison	12	10.3	1.39	686	30	Eutrophic	3.8	2.6
Odessa Lake	87	Lafayette	6	25.5	1.15	877	48	Eutrophic	3.3	4.7
Old Bethany City Reservoir	NA	Harrison	3	7.8	1.85	590	29	Mesotrophic	1.4	2.3
Pike Lake nr. dam	NA	Livingston	3	15.6	1.55	687	29	Eutrophic	1.2	2.8

Pony Express Lake nr Dam	240	DeKalb	13	31.9	0.76	1070	65	Eutrophic	5.2	4.5
Prairie Lee Lake nr. Dam	144	Jackson	16	24.7	0.95	858	49	Eutrophic	5.2	4.5
Ray County Comm. Lake	23	Ray	4	146.1	0.41	2033	163	Hypereutrophic	5.3	14.4
Riss Lake in Parkville, near dam	NA	Platte	4	4.5	2.07	347	12	Mesotrophic	2.2	1.8
Rocky Hollow Lake	20	Clay	11	46.4	0.61	961	88	Eutrophic	10.6	5.6
Rothwell Lake nr Dam	27	Randolph	14	31.7	1.14	864	52	Eutrophic	2.2	5.3
Santa Fe Lake	NA	Macon	3	46.2	1.10	1029	50	Eutrophic	1.8	7.5
Savannah City Reservoir nr. dam	20	Andrew	4	28.6	1.08	961	48	Eutrophic	4.2	4.8
Shelbina Lake nr. dam	45	Shelby	10	42.1	0.58	1091	101	Hypereutrophic	8.2	6.2
Smithville Lake nr dam	7190	Clay	27	20.5	1.01	847	34	Eutrophic	4.5	3.4
Spring Lake nr. dam	87	Adair	9	9.2	1.17	550	37	Eutrophic	5.4	2.1
Sterling Price Lake	23	Chariton	8	88.8	0.60	1531	110	Hypereutrophic	4.3	12.6
Sugar Creek Lake at dam	308	Randolph	25	24.6	0.83	755	48	Eutrophic	5.0	4.0
Sugar Lake, east end	403	Buchanan	5	194.7	0.21	2743	362	Hypereutrophic	43.5	28.1
Thomas Hill Res. nr. dam	4400	Randolph	14	14.7	0.66	760	51	Eutrophic	8.7	2.7
Unionville (New) Lake nr Dam	74	Putnam	20	37.5	0.57	1214	117	Eutrophic	7.8	5.4
Upper end of Lake Tapawingo	83	Jackson	3	32.8	0.68	675	59	Eutrophic	5.6	5.9
Vandalia Community Lake	35	Audrain	13	40.8	0.90	1069	75	Eutrophic	3.3	5.9
Vandalia Reservoir nr Dam	35	Audrain	4	31.6	1.08	1095	59	Eutrophic	4.7	5.6
Wakonda Lake nr. boat ramp	78	Lewis	6	59.0	0.74	1160	96	Eutrophic	4.0	8.6
Water Works Lake	22	Randolph	12	32.6	0.97	878	54	Eutrophic	2.3	5.2
Watkins Mill Lake	87	Clay	27	20.6	0.87	653	40	Eutrophic	4.4	3.7
Waukomis Lake nr Dam	76	Platte	21	10.2	1.63	544	23	Mesotrophic	2.1	2.3
Weatherby Lake nr Dam	185	Platte	17	6.3	4.00	408	17	Mesotrophic	1.5	2.0
Whiteside Lake	28	Lincoln	4	8.4	2.28	674	21	Mesotrophic	0.8	1.9
Willow Brook Lake	53	DeKalb	6	49.9	0.65	1238	95	Eutrophic	9.6	6.9
Worth County Lake	17	Worth	3	56.8	0.66	1423	77	Eutrophic	4.0	10.6

Ozark Plains

Adrian Reservoir nr. dam	NA	Bates	3	30.7	0.41	880	63	Eutrophic	11.7	5.3
Amarugia Highlands Lake	39	Cass	10	12.4	1.04	657	49	Eutrophic	7.9	2.6
Atkinson Lake	434	St. Clair	26	43.6	0.52	1102	75	Eutrophic	9.3	6.7
Blue Springs L. nr. Dam	642	Jackson	24	20.6	1.09	543	32	Eutrophic	3.2	3.5
Bushwhacker Lake	148	Vernon	6	14.6	1.32	603	29	Eutrophic	2.3	2.7
Butler Lake nr. dam	71	Bates	7	39.4	0.62	993	74	Eutrophic	4.7	6.0
Catclaw Lake	42	Jackson	4	39.1	0.42	1109	117	Eutrophic	24.4	8.6
Coot Lake	20	Jackson	4	40.2	0.55	1198	60	Eutrophic	5.9	7.6
Cottontail Lake nr Dam	22	Jackson	6	26.5	0.45	896	91	Eutrophic	19.0	6.7
Drexel City Reservoir South nr. dam	NA	Bates	3	35.2	0.99	1162	56	Eutrophic	2.3	5.3
Gopher Lake nr Dam	38	Jackson	6	45.6	0.50	938	97	Eutrophic	8.8	6.6
H.S. Truman Res. nr. Dam	55600	Benton	25	18.3	1.24	758	43	Eutrophic	3.5	2.6
Harmony Mission Lake	96	Bates	10	26.3	0.97	834	51	Eutrophic	3.7	3.7
Harrisonville Lake nr Dam	419	Cass	10	21.8	0.96	960	52	Eutrophic	6.6	4.1

Hazel Hill Lake	62	Johnson	15	37.1	0.79	1027	52	Eutrophic	4.4	5.9
Holden City Lake nr. dam	290.2	Johnson	10	18.0	0.73	885	45	Eutrophic	6.7	3.3
Jackrabbit Lake	25	Jackson	4	15.8	0.76	779	111	Eutrophic	16.2	4.7
Knob Noster S.P. Lake 2 (Clearfork) nr Dam	NA	Johnson	4	31.9	0.89	912	52	Eutrophic	3.0	5.6
Lake Buteo nr Dam	NA	Johnson	5	10.3	1.18	638	39	Eutrophic	4.3	2.9
Lake of the Woods-KC	7	Jackson	5	86.3	0.49	1016	126	Hypereutrophic	13.2	8.9
Lake Winnebago	272	Cass	8	21.6	0.95	819	46	Eutrophic	6.4	2.9
Lamar City Lk. nr. Dam	148	Barton	21	53.9	0.75	1145	84	Eutrophic	2.3	6.4
Lone Jack Lake nr. Dam	31	Jackson	3	20.3	1.72	657	29	Eutrophic	1.4	2.9
Montrose Lake	1444	Henry	11	65.3	0.27	1261	189	Hypereutrophic	47.2	12.5
Nell Lake	24	Jackson	4	59.6	0.54	1289	98	Eutrophic	7.7	8.2
North Lake	19	Cass	26	52.2	0.67	1095	110	Hypereutrophic	6.0	6.8
Penn Valley Park Lake	NA	Jackson	5	45.9	0.26	994	106	Hypereutrophic	20.2	10.6
Raintree Lake	248.1	Cass	24	18.1	0.72	843	54	Eutrophic	8.7	3.7
Spring Fork Lk. nr. Dam	178	Pettis	20	61.6	0.57	1263	169	Hypereutrophic	5.6	7.2
Westmoreland Lake nr. dam	NA	Pettis	6	5.1	2.34	622	18	Mesotrophic	0.8	1.8

Ozark Border

Alpine Lake in Innsbrook, Mo	NA	Warren	8	1.7	3.92	299	7	Oligotrophic	0.7	0.9
Ashland Lake nr Dam @ Baskett Wildlife Area	NA	Boone	11	60.0	0.59	1523	132	Hypereutrophic	7.7	7.3
Aspen Lake in Innsbrook, Mo	NA	Warren	8	9.6	1.74	492	22	Mesotrophic	1.7	2.0
Bella Vista Lake	NA	Cape Girardeau	10	10.2	1.54	515	23	Mesotrophic	1.7	2.3
Ben Branch Lake	37	Osage	7	15.3	1.90	658	21	Mesotrophic	0.9	2.7
Bennett Lake	NA	Howard	3	11.4	1.47	635	23	Mesotrophic	1.5	2.1
Binder Lake	127	Cole	26	39.0	0.84	865	61	Eutrophic	3.1	6.0
Castlenovo Lake in Innsbrook, Mo	NA	Warren	7	5.1	2.19	451	21	Mesotrophic	1.5	1.5
Creve Coeur Lake nr Dam	327	St. Louis	20	54.0	0.81	852	1159	Hypereutrophic	17.6	8.9
DC Rogers Lake nr. dam	195	Howard	12	9.7	1.19	543	34	Eutrophic	3.7	2.0
Eureka Lake	NA	St. Louis	3	14.6	0.70	NA	NA	Eutrophic	NA	NA
Fayette Lake No.2	62	Howard	9	24.7	0.85	819	52	Eutrophic	5.7	5.1
Foxtail Lake in Innsbrook, Mo	NA	Warren	8	27.8	0.78	785	62	Eutrophic	4.4	4.4
Glover Spring Lake nr. dam	23	Callaway	7	20.1	1.20	872	67	Eutrophic	8.8	5.1
Goose Creek Lake	308	Ste. Genevieve	11	3.8	2.41	388	13	Mesotrophic	1.9	1.2
Higbee City Lake nr Dam, west of Higbee	NA	Randolph	3	22.5	1.09	731	42	Eutrophic	2.7	4.3
Higbee Lake nr. dam	13	Randolph	3	8.5	1.64	637	28	Mesotrophic	2.6	2.6
Innsbrook Lake nr. dam	NA	Warren	8	10.6	1.39	545	27	Eutrophic	2.8	2.3
January Wabash Lake	NA	St. Louis	3	72.4	0.48	NA	NA	Hypereutrophic	NA	NA
Jennings Lake	NA	St. Louis	12	50.3	0.81	1287	320	Hypereutrophic	5.4	8.9
Lake Boutin, Trail of Tears S.P., nr. dam	NA	Cape Girardeau	10	15.8	1.66	640	24	Mesotrophic	1.5	3.5
Lake Eleanor, Sherwood Lakes	NA	Warren	6	23.6	1.04	786	41	Eutrophic	1.8	4.7
Lake Forest (Lake Anne)	81	Ste. Genevieve	11	18.5	1.35	630	41	Eutrophic	1.7	3.4
Lake Girardeau	144	Cape Girardeau	10	37.9	0.92	840	54	Eutrophic	2.0	6.1
Lake Konstanz	NA	Warren	8	1.8	2.70	314	7	Oligotrophic	1.5	0.9
Lake Lucern nr Dam	41	Warren	10	9.7	1.35	573	26	Eutrophic	2.2	2.3

Lake Tishomingo nr. Dam	115	Jefferson	19	10.4	1.86	525	20	Mesotrophic	1.3	2.1
Lake Wanda Lee nr. dam	97	Ste. Genevieve	10	24.1	1.42	621	53	Eutrophic	2.7	4.1
Lake Wauwanoka nr. Dam	93	Jefferson	15	2.6	3.19	369	11	Oligotrophic	1.5	1.3
Lick Cr. Lake nr. Dam	NA	Boone	6	24.8	1.35	662	33	Eutrophic	1.5	3.3
Little Dixie Lk. nr Dam	176	Callaway	24	34.3	0.66	913	61	Eutrophic	4.3	4.9
Manito Lake	77	Moniteau	15	21.8	0.60	1022	105	Eutrophic	5.9	3.0
Perry County Community Lake	89	Perry	11	54.6	0.69	1103	122	Hypereutrophic	12.1	8.3
Phillips Lake	32	Boone	5	17.3	0.90	683	39	Eutrophic	4.4	3.3
Pinnacle Lake nr. dam	115	Montgomery	5	4.1	3.07	463	22	Mesotrophic	7.2	2.3
Prairie Home CA Lake #2 nr. center of dam	NA	Cooper	3	10.4	1.00	670	32	Eutrophic	2.7	2.9
Quarry Heights Lake	NA	Boone	7	24.2	2.02	502	41	Eutrophic	0.9	4.8
Red Fox Lake, Innsbrook, Mo.	NA	Warren	6	14.9	0.77	746	54	Eutrophic	3.8	2.4
Robin Hood Lakes, Sherwood Lakes	NA	Warren	6	33.5	0.90	1082	57	Eutrophic	2.3	5.5
Rocky Fork Lake	60	Boone	8	6.6	1.93	511	20	Mesotrophic	1.7	1.8
Sherwood Lake nr. dam	120	Warren	7	8.2	2.26	499	16	Mesotrophic	0.6	2.0
Simpson Park Lake (Grand Glaize Cr.)	NA	St. Louis	8	45.9	0.62	785	75	Eutrophic	7.0	6.2
St. Gallen Lake in Innsbrook, Mo.	NA	Warren	4	5.5	1.76	434	19	Mesotrophic	1.8	1.6
Stephens Lake	NA	Boone	5	9.3	1.38	504	35	Eutrophic	3.8	2.6
Sugar Hollow Lake, Sherwood Lakes	NA	Warren	6	22.6	1.15	867	38	Eutrophic	1.6	4.1
Tri City Lake nr Dam	NA	Boone	20	30.9	0.79	960	60	Eutrophic	4.8	4.7
Tywappity Community Lake	43	Scott	9	50.2	0.74	1097	57	Eutrophic	1.9	7.4
UMC Dairy Lake No. 3	NA	Boone	4	87.6	0.61	1871	435	Hypereutrophic	4.7	9.6
UMC Dairy Lake No.1	NA	Boone	7	135.0	0.49	2271	230	Hypereutrophic	5.1	16.5
Wanderfern Lake in Innsbrook, Mo	NA	Warren	8	8.6	1.74	501	23	Mesotrophic	1.7	2.1
Wellsville Lake, east end	NA	Montgomery	4	2.4	4.01	376	10	Oligotrophic	1.2	1.2
Whippoorwill Lake in Innsbrook, Mo.	NA	Warren	7	3.6	1.72	499	18	Mesotrophic	1.5	1.3
Whitecliff Park Lake	NA	St. Louis	9	26.6	1.78	755	34	Eutrophic	1.1	5.6

Ozark Highlands

Austin Community Lake	21	Texas	12	9.7	1.55	578	22	Mesotrophic	1.2	2.5
Bull Shoals Lake Mi. 32.4	9000	Taney	11	7.0	2.39	305	12	Mesotrophic	NA	NA
Clearwater Lake nr. Dam	1635	Wayne	27	6.1	1.77	208	15	Mesotrophic	2.1	1.5
Council Bluff Lake	423	Iron	26	2.3	3.48	214	8	Oligotrophic	0.7	0.8
Crane Lake	109	Iron	9	4.1	1.41	235	13	Mesotrophic	2.3	1.5
Fellows Lake near Dam	800	Greene	24	5.8	2.68	345	13	Mesotrophic	0.9	1.5
Fourche Creek Lake	49	Ripley	12	2.5	3.23	249	9	Oligotrophic	0.9	1.0
Fredricktown City Lake Intake - PDW	80	Madison	11	34.4	0.65	748	65	Eutrophic	4.7	4.9
Hematite (Bismarck) Lake	210	St. Francois	15	33.7	1.28	620	47	Eutrophic	1.8	4.8
Indian Hills Lake nr. dam	279	Crawford	15	18.3	1.03	623	35	Eutrophic	3.0	3.2
Lac Carmel nr. dam	NA	St. Francois	12	1.9	2.96	313	8	Oligotrophic	1.1	0.8
Lac Lafitte nr. dam	NA	St. Francois	3	2.2	3.96	349	6	Oligotrophic	0.7	0.9
Lake Capri-Terre du Lac Lakes	NA	St. Francois	25	1.6	4.84	293	6	Oligotrophic	0.6	0.7
Lake Killarney	61	Iron	7	28.1	0.91	566	54	Eutrophic	5.1	4.4
Lake Marseilles-Terre du Lac Lakes	NA	St. Francois	10	2.2	3.73	348	9	Oligotrophic	0.8	0.9

Lake Shayne-Terre du Lac Lakes	NA	Washington	24	1.4	3.24	257	6	Oligotrophic	1.2	0.7
Lake Springfield nr Dam	293	Greene	13	33.5	0.61	1033	51	Eutrophic	11.6	4.5
Lake Taneycomo nr. Dam	2119	Taney	21	7.2	1.85	741	22	Mesotrophic	14.1	NA
Lake Wappapello nr. Dam	8200	Wayne	27	34.3	0.83	613	41	Eutrophic	4.2	5.7
Little Prairie Lake	95	Phelps	26	8.7	1.34	470	25	Mesotrophic	2.8	1.7
Loggers Lake	21	Shannon	8	2.9	3.12	213	9	Oligotrophic	0.6	1.0
LOTO just ab. Bagnell Dam	59520	Miller	20	15.4	1.83	589	28	Eutrophic	1.7	2.4
Lower Taum Sauk Res. Nr Dam	200	Reynolds	10	3.6	1.99	199	12	Mesotrophic	2.0	1.1
Mac Lake	28	Dent	10	18.5	1.69	633	30	Eutrophic	1.5	3.3
McCormack Lake	9	Oregon	3	0.9	3.31	118	5	Oligotrophic	0.5	0.5
McDaniel Lake near Dam	218	Greene	22	15.4	1.35	449	31	Eutrophic	1.7	3.0
Miller Community Lake	NA	Carter	12	7.5	1.50	502	20	Mesotrophic	1.4	2.5
Noblett Lake	26	Douglas	10	2.7	2.57	204	12	Oligotrophic	0.8	0.9
Norfolk L. @ Tecumseh	1000	Ozark	6	6.3	1.66	634	23	Mesotrophic	4.5	2.0
Northwoods Lake	77	Gasconade	13	4.6	1.32	443	22	Mesotrophic	3.1	1.4
Peaceful Valley Lake	158	Gasconade	14	26.4	1.44	788	34	Eutrophic	1.7	4.3
Pinewoods Lake	22	Carter	10	17.3	1.44	637	29	Eutrophic	0.8	3.9
Pomme de Terre L. at dam	7820	Hickory	25	16.4	1.74	554	28	Eutrophic	1.2	2.8
Ripley County Lake	18	Ripley	10	17.2	1.83	631	23	Mesotrophic	0.8	3.5
Roby Lake	10	Texas	10	3.6	2.12	421	15	Mesotrophic	1.2	1.3
Shawnee (Turner) Lake	15	Dent	9	13.8	1.78	558	21	Mesotrophic	1.1	2.8
Shepard Mountain Lake Intake - PDW	NA	Iron	3	18.9	1.38	405	28	Eutrophic	1.2	2.9
Sims Valley Lake	42	Howell	10	13.8	1.18	494	25	Eutrophic	1.8	3.6
St. Joe State Park Lakes, Monsanto Lake	18	St. Francois	11	2.3	2.06	379	10	Oligotrophic	1.7	1.1
Stockton Lake nr. Dam	23680	Cedar	27	6.9	2.81	422	12	Mesotrophic	1.3	1.6
Sunnen Lake	206	Washington	14	3.3	2.73	283	13	Mesotrophic	1.5	1.0
Table Rock Lk. nr. Dam	41776	Stone	27	5.0	3.40	397	10	Oligotrophic	0.8	1.4
Timberline Lakes - large lake	NA	St. Francois	12	1.6	4.28	294	8	Oligotrophic	0.7	0.6

Appendix E

Other Waters Rated as Impaired and Believed to be Impaired

The following list includes classified waters in Missouri found to be impaired, but which do not qualify for Section 303(d) listing. This list includes waters with approved TMDLs, waters where sufficient pollution control measures are in place, waters which are impaired by measures other than discrete pollutants, and other waters which were not approved for 303(d) listing by the Clean Water

WBID	Waterbody Name	Impaired Size (mi/acres)	County	Cause	Source	Category
4083.00	Barker Creek tributary (C)	1.2	Henry	pH	Source Unknown	4A
4083.00	Barker Creek tributary (C)	1.2	Henry	Sulfates	Source Unknown	4A
1746.00	Big Bottom Cr. (C)	0.6	Ste. Genevieve	Ammonia, Total	Municipal Point Source Discharges	4A
1746.00	Big Bottom Cr. (C)	1.5	Ste. Genevieve	Oxygen, Dissolved	Municipal Point Source Discharges	4A
2916.00	Big Cr.(P)	1.8	Wayne/Iron	Cadmium	Ind./Comm. Site Strmwtr Disch, Permitted	4A
2074.00	Big R.(P)	111.2	Jefferson	Lead	Mill Tailings	4A
2080.00	Big R. (P)	133	Jefferson/Washington	Lead	Mill Tailings	4A
2080.00	Big R.(P)	81.3	Jefferson/Washington	Lead	Mine Tailings	4A
2080.00	Big R. (P)	52.7	Jefferson/Washington	Sedimentation/Siltation	Mill Tailings	4A
0417.00	Blue R. (P)	4.4	Jackson	Chlordane in Fish Tissue	Nonpoint Source	4A
3118.00	Buffalo Ditch (P)	17.3	Dunklin	Oxygen, Dissolved	Source Unknown	4A
3941.00	Cave Spring Br.(US)	4.4	McDonald	Nitrogen, Total	Industrial Point Source Discharge	4A
3203.00	Center Cr. (P)	38	Jasper	Zinc	Mill Tailings	4A
0640.00	Chariton R. (P)	111	Chariton/Putnam	Escherichia coli	Agriculture	4A
3168.00	Chat Cr. (C)	2.1	Lawrence	Zinc	Subsurface, Hardrock, Mining	4A
1706.00	Coldwater Cr.(C)	13.8	St. Louis	Escherichia coli	Urban Runoff/Storm Sewers	4A
1703.00	Creve Coeur Cr. (C)	3.8	St. Louis	Escherichia coli	Urban Runoff/Storm Sewers	4A
1145.00	Dry Auglaize Cr. (P)	3	Laclede	Cause Unknown	Source Unknown	4B
1145.00	Dry Auglaize Cr.(P)	1	Laclede	Oxygen, Dissolved	Source Unknown	4B
0811.00	E. Brush Cr. (C)	1.1	Moniteau	Oxygen, Dissolved	Municipal Point Source Discharges	4B
2186.00	Fishpot Cr.(P)	3.5	St. Louis	Escherichia coli	Urban Runoff/Storm Sewers	4A
2168.00	Flat River Cr. (C)	9.4	St. Francois	Lead	Mill Tailings	4A
2168.00	Flat River Cr. (C)	10	St. Francois	Lead	Mine Tailings	4A
2168.00	Flat River Cr. (C)	4.7	St. Francois	Sedimentation/Siltation	Mill Tailings	4A
2168.00	Flat River Cr. (C)	4.7	St. Francois	Zinc	Mill Tailings	4A
1842.00	Fox Cr. (P)	7.2	St. Louis	Aquatic Macroinvertebrate Bioassessme	Source Unknown	4C
0883.00	Gabriel Cr.(C)	13.6	Morgan	Oxygen, Dissolved	Municipal Point Source Discharges	4B
0430.00	Grand R. (P)	8	Livingston/Worth	Fishes Bioassessments	Channelization	4C
0593.00	Grand R. (P)	56	Chariton/Livingston	Escherichia coli	Nonpoint Source	4A
0593.00	Grand R.(P)	11.5	Chariton/Livingston	Fishes Bioassessments	Channelization	4A
1008.00	Hinkson Cr. (C)	6.8	Boone	Cause Unknown	Urban Runoff/Storm Sewers	4A
1007.00	Hinkson Cr. (P)	7.6	Boone	Cause Unknown	Urban Runoff/Storm Sewers	4A
1251.00	Honey Cr. (C)	8.5	Henry	Sulfates	Coal Mining	4A
1946.00	Indian Cr. (P)	1.9	Washington	Lead	Mill Tailings	4A
2681.00	Jacks Fk.(P)	7.5	Shannon/Texas	Escherichia coli	Municipal Point Source Discharges	4A
2681.00	Jacks Fk. (P)	7.5	Shannon/Texas	Escherichia coli	Other Recreational Pollution Sources	4A
3233.00	Joyce Cr. (C)	4.5	Barry	Escherichia coli	Nonpoint Source	4A
7314.00	Lake Taneycomo (L2)	246	Taney	Dissolved oxygen saturation	Dam or Impoundment	4A
7356.00	Lamar Lake (L1)	148	Barton	Nutrient/Eutrophication Biol. Indicators	Nonpoint Source	4A
3105.00	Lateral #2 Main Ditch (P)	11.5	Stoddard	Sedimentation/Siltation	Nonpoint Source	4A
1438.00	L. Lindley Cr.(C)	3.7	Dallas	Aquatic Macroinvertebrate Bioassessme	Source Unknown	4B
0606.00	Locust Cr. (P)	19.4	Chariton/Putnam	Fishes Bioassessments	Channelization	4A
0857.00	Long Br.(C)	6	Pettis/Johnson	Cause Unknown	Source Unknown	4A

3652.00	L. Osage R. (C)	23.6	Vernon	Dissolved oxygen saturation	Source Unknown	4A
1381.00	L. Sac R. (P)	37	Polk/Greene	Escherichia coli	Agriculture	4A
1381.00	L. Sac R. (P)	37	Polk/Greene	Escherichia coli	Nonpoint Source	4A
2814.00	Main Ditch (C)	1	Butler	Ammonia, Un-ionized	Municipal Point Source Discharges	4A
2814.00	Main Ditch(C)	13	Butler	Oxygen, Dissolved	Source Unknown	4A
1308.00	Marmaton R. (P)	35.7	Vernon	Oxygen, Dissolved	Nonpoint Source	4A
2787.00	McKenzie Cr.(C)	4.7	Wayne	pH	Municipal Point Source Discharges	4A
2787.00	McKenzie Cr.(C)	4.7	Wayne	pH	Source Unknown	4A
2786.00	McKenzie Cr. (P)	6.3	Wayne	Oxygen, Dissolved	Municipal Point Source Discharges	4B
1284.00	Middle Fk. Tebo Cr. (C)	3	Henry	Total Dissolved Solids	Coal Mining	4A
1707.03	Mississippi R. (P)	0.4	Ste. Genevieve	Lead	Industrial Point Source Discharge	4A
1707.03	Mississippi R. (P)	0.4	Ste. Genevieve	Zinc	Industrial Point Source Discharge	4A
1234.00	Monegaw Cr. (C)	2.1	St. Clair	Sulfates	Coal Mining	4A
1300.00	Mound Br. (C)	8.9	Bates	Dissolved oxygen saturation	Source Unknown	4A
0674.00	Mussel Fk. (C)	58	Macon/Sullivan	Escherichia coli	Nonpoint Source	4A
0056.00	N. Fabius R.(P)	92	Marion/Schuyler	Habitat Assessment, Streams	Channelization	4C
0942.00	N. Moreau Cr.(P)	10.9	Cole/Moniteau	Oxygen, Dissolved	Source Unknown	4A
1031.00	Osage R.(P)	9.7	Osage/Miller	Aquatic Macroinvertebrate Bioassessme	Dam or Impoundment	4C
1387.00	Pea Ridge Cr. (P)	1.5	Greene	Aquatic Macroinvertebrate Bioassessme	Source Unknown	4C
0216.00	Peruque Cr. (P)	0.3	St. Charles	Cause Unknown	Dam or Impoundment	4C
1444.00	Piper Cr. (P)	5.3	Polk	Aquatic Macroinvertebrate Bioassessme	Source Unknown	4A
3232.00	Pogue Cr.(C)	2.5	Barry	Escherichia coli	Nonpoint Source	4A
2128.00	Pond Cr.(C)	1	Washington	Sedimentation/Siltation	Mill Tailings	4A
2128.00	Pond Cr.(C)	1	Washington	Zinc	Mill Tailings	4A
2859.00	Saline Cr. (P)	1.7	Madison	Nickel	Mine Tailings	4A
0071.00	S. Fabius R. (P)	4.2	Marion/Knox	Fishes Bioassessments	Channelization	4C
2170.00	Shaw Br.(C)	1.2	St. Francois	Lead	Mill Tailings	4A
2120.00	Shibboleth Br. (C)	3	Washington	Lead	Mill Tailings	4A
2120.00	Shibboleth Br. (C)	3	Washington	Zinc	Mill Tailings	4A
2119.00	Shibboleth Br. (P)	1	Washington	Lead	Mill Tailings	4A
2119.00	Shibboleth Br. (P)	1	Washington	Zinc	Mill Tailings	4A
3231.00	Shoal Cr. (C)	5	Barry	Escherichia coli	Nonpoint Source	4A
3230.00	Shoal Cr. (P)	31.4	Newton/Barry	Escherichia coli	Nonpoint Source	4A
1870.00	Spring Cr.(P)	5.1	Dent	Oxygen, Dissolved	Municipal Point Source Discharges	4A
1870.00	Spring Cr.(P)	5.1	Dent	Solids, Suspended/Bedload	Municipal Point Source Discharges	4A
2835.00	St. Francis R. (P)	8.7	Wayne/St. Francois	Oxygen, Dissolved	Municipal Point Source Discharges	4A
0710.00	Stinson Cr. (C)	1.9	Callaway	Oxygen, Dissolved	Municipal Point Source Discharges	4A
0710.00	Stinson Cr. (C)	1.9	Callaway	Oxygen, Dissolved	Natural Conditions, UAA Needed	4A
0959.00	Straight Fk. (C)	6	Morgan	Chloride	Municipal Point Source Discharges	4A
0686.00	Sugar Cr. (P)	6.8	Randolph	pH	Coal Mining, Subsurface	4A
3822.00	Town Br. (P)	2.5	Polk	Cause Unknown	Source Unknown	4A
3822.00	Town Br.(P)	1.1	Polk	Total Suspended Solids - TSS	Municipal Point Source Discharges	4A
3822.00	Town Br. (P)	1.1	Polk	Total Suspended Solids - TSS	Source Unknown	4A
2850.00	Trace Cr. (C)	0.4	Madison	pH	Natural Sources	4A
1288.00	Trib. M. Fk. Tebo Cr. (C)	3.1	Henry	pH	Coal Mining	4A
1288.00	Trib. M. Fk. Tebo Cr. (C)	3.1	Henry	Total Dissolved Solids	Coal Mining	4A
3940.00	Trib. to Big Cr. (US)	0.6	Iron	Cadmium	Ind./Comm. Site Strmwtr Disch, Permitted	4A
3940.00	Trib. to Big Cr. (US)	0.6	Iron	Zinc	Ind./Comm. Site Strmwtr Disch, Permitted	4A

1225.00	Trib. to Big Otter Cr. (C)	1	Henry	pH	Coal Mining	4A
3663.00	Trib. to Indian Cr. (C)	0.3	Washington	Lead	Subsurface, Hardrock, Mining	4A
3490.00	Trib. to L. Muddy Cr. (C)	1	Pettis	Temperature, water	Industrial Point Source Discharge	4A
3216.00	Turkey Cr. (P)	7.7	Jasper	Zinc	Mill Tailings	4A
3282.00	Turkey Cr. (P)	1.2	St. Francois	Oxygen, Dissolved	Source Unknown	4A
2863.00	Village Cr. (P)	1.9	Madison	Sedimentation/Siltation	Mill Tailings	4A
1708.00	Watkins Cr.(C)	2.8	St. Louis City	Escherichia coli	Urban Runoff/Storm Sewers	4A
0613.00	W. Fk. Locust Cr.(C)	17	Sullivan	Oxygen, Dissolved	Source Unknown	4A
0400.00	W. Fk. Sni-a-bar Cr. (P)	9	Jackson	Oxygen, Dissolved	Municipal Point Source Discharges	4A
0400.00	W. Fk. Sni-a-bar Cr. (P)	9	Jackson	Oxygen, Dissolved	Source Unknown	4A
7009.00	Wyaconda Lake (L1)	9	Clark	Atrazine	Crop Production,Crop Land or Dry Land	4A

Appendix F

Potentially Impaired Waters

The following waters are those for which there is some indication that an impairment to some designated use may exist, but the current data or information indicating the impairment do not meet the data requirements set out by Missouri's Section 303(d) Listing Methodology. The Department will make an effort to conduct further monitoring on these waters in order to determine defensibly whether these impairments actually exist.

Waterbody Id	Waterbody Name	Size	Potential Pollutant or Condition	Category Code
0334.00	Agee Cr.	4.80	Habitat Degradation	3B
2093.00	Allen Br.	1.80	Fish Bioassessments/Unknown	3B
1799.00	Apple Cr.	44.80	Aquatic Macroinvertebrate Bioassessments/Unkown	2B
0282.00	Arapahoe Cr.	8.00	Habitat Degradation	3B
2880.00	Back Cr.	3.80	Low Dissolved Oxygen	3B
1209.00	Barker Cr.	15.00	pH	3B
7068.00	Bean Lake	420.00	nutrients all supporting, but just below the site specific critiera; limited fish tissue Hg/chlordane da	3B
0115.00	Bear Cr.	36.20	Low Dissolved Oxygen	3B
0272.00	Bear Cr.	9.80	Habitat Degradation	3B
0416.00	Bear Cr.	4.50	Habitat Degradation	3B
1015.00	Bear Cr.	6.00	Fish Bioassessments/Unknown	3B
1220.00	Bear Cr.	7.40	Habitat Degradation	3B
3265.00	Beaver Br.	2.00	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
3266.00	Beaver Br.	3.50	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
3267.00	Beaver Br.	1.50	Habitat Degradation	3B
1509.00	Beaver Cr.	5.70	Fish Bioassessments/Unknown	3B
0273.00	Bee Cr.	29.40	Habitat Degradation	3B
3966.00	Bee Fk.	5.90	Heavy metals in Sediment	2B
2179.00	Belew Cr.	7.00	Fish Bioassessments/Low Dissolved Oxygen	3B
0220.00	Belleau Cr.	5.10	Habitat Degradation	3B
1250.00	Big Cr.	70.50	Low Dissolved Oxygen	2B
1608.00	Bigelow's Cr.	5.00	Low Dissolved Oxygen	3B
7185.00	Binder Lake	127.00	pH	2B
0891.00	Blackwater R.	79.40	Habitat Degradation	2B
0421.00	Blue R.	12.00	Bacteria	2B
0993.00	Blythes Cr.	6.90	Nutients	3B
0032.00	Bobs Cr.	1.70	nutrients all supporting, but just below the site specific critiera; limited fish tissue Hg/chlordane da	2B
1983.00	Brazil Cr.	13.90	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
0276.00	Brush Cr.	7.40	Habitat Degradation	3B
0408.00	Brush Cr.	5.90	Habitat Degradation	3B
2056.00	Brush Cr.	2.00	Fish Bioassessments/Unknown	3B
0336.00	Brushy Cr.	12.10	Habitat Degradation	3B
0377.00	Brushy Cr.	7.00	Habitat Degradation	3B
0395.00	Brushy Cr.	2.20	Habitat Degradation	3B
7159.00	Bucklin Lake	17.00	nutrients all supporting, but just below the site specific critiera; limited fish tissue Hg/chlordane da	2B
2422.00	Bull Cr.	5.00	Habitat Degradation	2B
3264.00	Bullskin Cr.	4.90	Fish Bioassessments/Unknown	2B
0363.00	Burr Oak Cr.	2.00	Habitat Degradation	3B
7120.00	Cameron Lake #1	25.00	Mercury in Fish Tissue	2B
2431.00	Camp Cr.	1.00	Fish Bioassessments/Unknown	3B

2833.00	Cane Cr.	9.80	Low Dissolved Oxygen	3B
2560.00	Caney Cr.	7.00	Fish Bioassessments/Unknown	3B
0389.00	Carroll Cr.	9.40	Habitat Degradation	3B
0322.00	Castile Cr.	40.20	Low Dissolved Oxygen	2B
3225.00	Cedar Cr.	2.20	Habitat Degradation	2B
7048.00	City Lake #2 - Perry	7.00	Atrazine	3B
0292.00	Clear Cr.	13.00	Habitat Degradation	3B
0388.00	Clear Cr.	5.00	Habitat Degradation	3B
0390.00	Clear Cr.	13.50	Habitat Degradation	3B
2082.00	Clear Cr.	4.40	Fish Bioassessments/Unknown	3B
0225.00	Cole Cr.	5.70	Habitat Degradation	3B
0269.00	Contrary Cr.	10.00	Mercury in Fish Tissue	3B
1459.00	Contrary Cr.	4.50	Fish Bioassessments/Unknown	3B
0132.00	Coon Cr.	11.80	Low Dissolved Oxygen	2B
0410.00	Cottonwood Cr.	3.90	Habitat Degradation	3B
1947.00	Courtois Cr.	1.70	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
0247.00	Cow Br.	4.40	Habitat Degradation	3B
0330.00	Crooked Cr.	2.80	Habitat Degradation	3B
0333.00	Crooked Cr.	4.00	Habitat Degradation	3B
0371.00	Crooked R.	58.10	Habitat Degradation	3B
0376.00	Crooked R.	7.50	Habitat Degradation	3B
2616.00	Cypress Ditch #1	9.70	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
0144.00	Davis Cr.	8.80	Low Dissolved Oxygen	3B
0255.00	Davis Cr.	3.50	Habitat Degradation	3B
0253.00	Davis Cr. Ditch	6.70	Habitat Degradation	3B
0320.00	Dicks Cr.	7.30	Habitat Degradation	3B
0268.00	Dillon Cr.	4.80	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
2998.00	Ditch #10	3.50	Mercury in Fish Tissue	3B
3813.00	Ditch #16	11.20	Low Dissolved Oxygen	3B
2617.00	Ditch #2	3.20	Low Dissolved Oxygen	3B
2077.00	Ditch Cr.	1.80	Fish Bioassessments/Unknown	3B
2776.00	Ditch to Black R.	10.70	Habitat Degradation	3B
3418.00	Dry Cr.	9.30	Fish Bioassessments/Unknown	3B
1862.00	Dry Fk.	23.30	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
1314.00	Dry Wood Cr.	29.90	Sulfates	2B
1265.00	East Cr.	9.40	Low Dissolved Oxygen	2B
2085.00	Ebo Cr.	1.60	Fish Bioassessments/Unknown	3B
0288.00	E. Br. Elkhorn Cr.	4.70	Habitat Degradation	3B
0257.00	E. Br. Squaw Cr.	4.20	Habitat Degradation	3B
3107.00	E. Ditch #1	22.00	Low Dissolved Oxygen	3B
0414.00	Edmondson Cr.	1.90	Habitat Degradation	3B
0373.00	E. Fk. Crooked R.	6.40	Habitat Degradation	3B
0386.00	E. Fk. Fishing R.	12.90	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
0249.00	E. Fk. L. Tarkio Cr.	17.80	Habitat Degradation	3B
0932.00	E. Fk. Post oak Cr.	12.20	Habitat Degradation	3B
0398.00	E. Fk. Shoal Cr.	2.90	Bacteria	2B
0402.00	E. Fk. Sni-a-bar Cr.	9.60	Habitat Degradation	3B
0287.00	Elkhorn Cr.	11.80	Aquatic Macroinvertebrate Bioassessments/Unkown	3B

0331.00	Elm Grove Br.	4.20	Habitat Degradation	3B
3370.00	Fassnight Cr.	2.80	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
1705.00	Fee Fee Cr. (old)	1.00	Habitat Degradation	3B
1607.00	Femme Osage Cr.	2.00	Fish Bioassessments/Unknown	3B
4120.00	Fenton Creek tributary	1.50	Habitat Degradation	2B
7201.00	Finger Lakes	118.00	Mercury in Fish Tissue	2B
0375.00	Fire Br.	5.40	Habitat Degradation	3B
0318.00	First Cr.	4.70	Bacteria	3B
0394.00	Fishing R.	8.50	Bacteria	2B
1885.00	Fishwater Cr.	4.80	Low Dissolved Oxygen	3B
3587.00	Fleck Cr.	4.30	Sulfates	3B
0289.00	Florida Cr.	8.40	Habitat Degradation	3B
3942.00	Foster Br.	1.10	Low Dissolved Oxygen	3B
3373.00	Galloway Cr.	3.20	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
0407.00	Garrison Fk.	6.80	Habitat Degradation	3B
1496.00	Gasconade R.	11.20	Fish Bioassessments/Unknown	3B
0233.00	Greys Lake	5.20	Habitat Degradation	3B
0321.00	Grove Cr.	3.30	Habitat Degradation	3B
3204.00	Grove Cr.	2.90	Aquatic Macroinvertebrate and Fish Bioassessments/Unknown	2B
0285.00	Hayzlett Br.	2.40	Habitat Degradation	3B
2181.00	Heads Cr.	2.70	Fish Bioassessments/Unknown	3B
0596.00	Hickory Br.	6.80	Low Dissolved Oxygen	2B
0266.00	Hickory Cr.	1.00	Habitat Degradation	3B
0308.00	Hickory Cr.	1.20	Habitat Degradation	3B
0335.00	Hickory Cr.	1.50	Habitat Degradation	3B
0229.00	High Cr.	6.30	Habitat Degradation	3B
0228.00	High Cr. Ditch	3.70	Habitat Degradation	3B
0307.00	Highly Cr.	3.90	Habitat Degradation	3B
0350.00	Holland Br.	3.00	Habitat Degradation	3B
0351.00	Holtzclaw Cr.	2.00	Habitat Degradation	3B
0338.00	Honey Cr.	6.70	Habitat Degradation	3B
0919.00	Honey Cr.	7.00	Habitat Degradation	3B
0354.00	Horse Fk.	4.40	Atrazine	3B
0306.00	Huff Cr.	2.00	Habitat Degradation	3B
0212.00	Indian Camp Cr.	3.50	Habitat Degradation	2B
3256.00	Indian Cr.	30.80	Habitat Degradation	2B
7288.00	Indian Lake	279.00	Mercury in Fish Tissue	2B
0234.00	Iowa Ditch	2.80	Habitat Degradation	3B
0286.00	Jenkins Cr.	7.20	Habitat Degradation	3B
1719.00	Joachim Cr.	30.20	Lead	2B
3968.00	Jones Br.	0.00	VOCs in Sediment	3B
0974.00	Jones Cr.	4.00	Habitat Degradation	3B
0275.00	Jordan Br.	7.20	Habitat Degradation	3B
0329.00	Jordan Cr.	1.40	Habitat Degradation	3B
0384.00	Keeney Cr.	4.90	Habitat Degradation	3B
0262.00	Kimsey Cr.	0.80	Habitat Degradation	3B
0263.00	Kimsey Cr.	2.50	Habitat Degradation	3B
0264.00	Kimsey Cr.	6.70	Habitat Degradation	3B

1334.00	Kitten Cr.	7.20	Low Dissolved Oxygen	3B
7064.00	Lake Contrary	291.00	Nutrients	3B
0359.00	Lake Cr.	5.70	Habitat Degradation	3B
1656.00	L. Berger Cr.	1.20	Aquatic Macroinvertebrate and Fish Bioassessments/Unknown	3B
0424.00	L. Blue R.	4.30	Habitat Degradation	3B
3591.00	L. Fox Cr.	0.70	Fish Bioassessments/Unknown	3B
7111.00	Limpp Community State Lake	27.00	Mercury in Fish Tissue	2B
0280.00	Lincoln Cr.	7.40	Habitat Degradation	3B
0243.00	Long Br.	3.00	Habitat Degradation	3B
3531.00	Long Grove Br.	3.20	Low Dissolved Oxygen	3B
1617.00	Lost Cr.	6.40	Fish Bioassessments/Unknown	3B
0403.00	L. Sni-a-bar Cr.	6.70	Habitat Degradation	3B
0404.00	L. Sni-a-bar Cr.	7.50	Habitat Degradation	3B
0409.00	L. Tabo Cr.	9.20	Habitat Degradation	3B
0250.00	L. Tarkio Cr.	15.40	Habitat Degradation	3B
0251.00	L. Tarkio Ditch	6.60	Habitat Degradation	3B
0328.00	L. Third Fk. Platte R.	26.00	Habitat Degradation	3B
0425.00	Lumpkin Cr.	0.50	Habitat Degradation	3B
0267.00	Mace Cr.	5.80	Habitat Degradation	3B
3277.00	Mason Springs Valley	1.00	Bacteria	3B
1338.00	McCarty Cr.	13.20	Habitat Degradation	3B
7319.00	McCormack Lake	9.00	Mercury in Fish Tissue	3B
0213.00	McCoy Cr.	1.90	Nutrients	2B
0231.00	McElroy Cr.	3.00	Habitat Degradation	3B
0324.00	McGuire Br.	5.40	Habitat Degradation	3B
1321.00	McKill Cr.	2.70	Sulfates and pH	3B
1324.00	McKill Cr.	2.20	Sulfates and pH	3B
0031.00	McLean Cr.	6.60	Nutrients	3B
2185.00	Meramec R.	15.70	Lead	2B
0691.00	M. Fk. Little Chariton R.	31.50	Sulfates	2B
3415.00	Middle Big Cr.	9.40	Low Dissolved Oxygen	3B
0258.00	Middle Br. Squaw Cr.	3.00	Habitat Degradation	3B
2744.00	Middle Fk. Black R.	21.00	Fish Bioassessments/Unknown	2B
0245.00	Middle Tarkio Cr.	10.00	Habitat Degradation	3B
0159.00	Mill Cr.	5.00	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
0265.00	Mill Cr.	10.00	Habitat Degradation	3B
0301.00	Mill Cr.	10.80	Habitat Degradation	3B
0740.00	Millers Cr.	1.90	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
1707.02	Mississippi R.	28.30	Bacteria	2B
1544.00	Mistaken Cr.	1.50	Habitat Degradation	3B
0755.00	Moniteau Cr.	14.40	Sulfates and pH	3B
1315.00	Moores Br.	3.00	Habitat Degradation	3B
0302.00	Moss Br.	2.40	Habitat Degradation	3B
0369.00	Moss Cr.	13.70	Habitat Degradation	3B
0426.00	Mouse Cr.	1.50	Low Dissolved Oxygen	2B
0343.00	Mozingo Cr.	5.10	Habitat Degradation	3B
0291.00	Muddy Cr.	5.20	Habitat Degradation	3B
0391.00	Muddy Fk.	8.40	Aquatic Macroinvertebrate Bioassessments/Unkown	3B

0277.00	Naylor Cr.	1.00	Habitat Degradation	3B
2752.00	Neals Cr.	3.20	Nickel in Sediment	2B
0392.00	New Hope Cr.	5.50	Habitat Degradation	3B
0309.00	Nichols Cr.	4.60	Habitat Degradation	3B
0344.00	Norvey Cr.	9.30	Habitat Degradation	3B
0049.00	N. Wyaconda R.	9.20	Habitat Degradation	3B
0284.00	Old Chan. Nodaway R.	10.00	Habitat Degradation	3B
0294.00	Old Chan. Nodaway R.	1.20	Habitat Degradation	3B
0295.00	Old Chan. Nodaway R.	2.00	Habitat Degradation	3B
0297.00	Old Chan. Nodaway R.	1.50	Habitat Degradation	3B
0298.00	Old Chan. Nodaway R.	1.00	Habitat Degradation	3B
0299.00	Old Chan. Nodaway R.	2.50	Habitat Degradation	3B
0300.00	Old Chan. Nodaway R.	3.70	Habitat Degradation	3B
0304.00	Old Chan. Nodaway R.	2.50	Habitat Degradation	3B
0305.00	Old Chan. Nodaway R.	2.80	Habitat Degradation	3B
0311.00	Old Chan. Nodaway R.	1.00	Habitat Degradation	3B
0325.00	Old Chan. Platte R.	3.40	Habitat Degradation	3B
0326.00	Old Chan. Platte R.	2.20	Habitat Degradation	3B
0332.00	Old Chan. Platte R.	4.00	Habitat Degradation	3B
0341.00	Old Chan. Platte R.	5.00	Habitat Degradation	3B
0348.00	Old Chan. Platte R.	1.00	Habitat Degradation	3B
0368.00	Old Chan. Wakenda Cr.	3.00	Habitat Degradation	3B
0260.00	Old Ch. L. Tarkio Cr.	5.30	Habitat Degradation	3B
0261.00	Old Ch. L. Tarkio Cr.	8.30	Habitat Degradation	3B
0238.00	Old Ch. Nishnabotna R.	13.70	Habitat Degradation	3B
0240.00	Old Ch. Nishnabotna R.	3.00	Habitat Degradation	3B
0026.00	Old Kings Lake Cr.	6.20	Nutrients	3B
1472.00	Osage Fk.	69.00	Bacteria	2B
2962.00	Otter Cr.	6.00	Low Dissolved Oxygen	3B
0357.00	Palmer Cr.	12.20	Habitat Degradation	3B
0358.00	Palmer Cr.	2.80	Habitat Degradation	3B
7441.00	Palmer Lake	102.00	Mercury in Fish Tissue	2B
0521.00	Panther Cr.	5.00	Habitat Degradation	3B
2425.00	Peckout Hollow	1.80	Habitat Degradation	3B
0283.00	Pedlar Cr.	5.40	Habitat Degradation	3B
1616.00	Peers Slough	3.00	Fish Bioassessments/Unknown	3B
0349.00	Pigeon Cr.	7.20	Habitat Degradation	3B
1728.00	Plattin Cr.	19.90	Ammonia	2B
2058.00	Pleasant Valley Cr.	1.70	Habitat Degradation	3B
2192.00	Pomme Cr.	1.80	Habitat Degradation	3B
2127.00	Pond Cr.	1.30	Zinc in Sediment and Sediment Deposition	2B
0313.00	Prairie Cr.	3.70	Habitat Degradation	3B
2037.00	Red Oak Cr.	5.20	Low Dissolved Oxygen	2B
0136.00	Reese Fk.	7.00	Low Dissolved Oxygen	3B
0347.00	Riggin Br.	1.90	Habitat Degradation	3B
3827.00	River des Peres	3.70	Chloride and Bacteria	3B
0355.00	Roberts Br.	2.00	Atrazine	3B
0236.00	Rock Cr.	2.20	Habitat Degradation	3B

0237.00	Rock Cr.	19.00	Low Dissolved Oxygen	3B
0378.00	Rocky Fk.	4.00	Habitat Degradation	3B
0382.00	Rollins Cr.	7.00	Habitat Degradation	3B
0278.00	Rush Cr.	4.50	Bacteria	3B
2189.00	Saline Cr.	1.80	Low Dissolved Oxygen	3B
2190.00	Saline Cr.	2.30	Low Dissolved Oxygen	3B
0413.00	Salt Br.	5.70	Habitat Degradation	3B
0290.00	Sand Cr.	4.90	Habitat Degradation	3B
0952.00	Scott Br.	0.50	Ammonia and Low Dissolved Oxygen	3B
0317.00	Second Cr.	11.50	Habitat Degradation	3B
1319.00	Second Nicolson Cr.	4.50	Sulfates	2B
7253.00	See Tal Lake	11.00	Mercury in Fish Tissue	3B
0921.00	S. Fk. Blackwater R.	5.70	Habitat Degradation	3B
0293.00	S. Fk. Clear Cr.	6.00	Habitat Degradation	3B
0385.00	Shackelford Br.	5.90	Habitat Degradation	3B
0450.00	Shain Cr.	13.00	Nutrients	3B
0087.00	Sharpsburg Br.	1.50	Habitat Degradation	3B
2865.00	Shays Cr.	1.70	Arsenic and Lead in Sediment	3B
0396.00	Shoal Cr.	10.30	Habitat Degradation	3B
0397.00	Shoal Cr.	10.60	Low Dissolved Oxygen	2B
1934.00	Shoal Cr.	7.70	Fish Bioassessments/Unknown	3B
3229.00	Shoal Cr.	0.50	Bacteria	3B
0739.00	Smith Cr.	1.50	pH and Conductivity	3B
0353.00	Smith Fk.	3.00	Habitat Degradation	3B
7077.00	Smithville Lake	7190.00	Low Dissolved Oxygen	3B
0401.00	Sni-a-bar Cr.	4.30	Habitat Degradation	3B
3369.00	South Cr.	3.80	Bacteria	2B
0003.00	South R.	16.30	Nutrients	2B
7187.00	Spring Fork Lake	178.00	Nutrients	2B
3159.00	Spring R.	0.50	Metals in Sediment	3B
3167.00	Spring R.	1.00	Bacteria	3B
0252.00	Squaw Cr.	21.00	Habitat Degradation	3B
1486.00	Steins Cr.	16.60	Fish Bioassessments/Unknown	3B
2355.00	Stewart Cr.	3.00	Fish Bioassessments/Unknown	3B
2751.00	Strother Cr.	6.00	Aquatic Macroinvertebrate and Fish Bioassessments/Unknown	2B
3965.00	Strother Cr.	0.90	Metals	2B
1030.00	Sugar Br.	3.00	Nutrients	3B
0270.00	Sugar Cr.	3.00	Habitat Degradation	3B
0271.00	Sugar Cr.	6.50	Habitat Degradation	3B
2866.00	Sweetwater Br.	1.00	Heavy metals in Sediment	3B
2867.00	Sweetwater Br.	1.70	Lead in Sediment	3B
0405.00	Tabo Cr.	11.40	Habitat Degradation	3B
0406.00	Tabo Cr.	8.40	Habitat Degradation	3B
2509.00	Tabor Cr.	5.60	Aquatic Macroinvertebrate and Fish Bioassessments/Unknown	3B
7045.00	Teal Lake	84.00	Mercury in Fish Tissue	3B
3130.00	Tenmile Pond	5.10	Nutrients and DDT	3B
3763.00	Tiff Cr.	2.10	Fish Bioassessments/Unknown	3B
2759.00	Toms Cr.	2.20	Metals	3B

0274.00	Trib. to Bee Cr.	1.80	Habitat Degradation	3B
3967.00	Trib. to Bee Cr.	0.50	Metals	3B
2923.00	Trib. to Big Cr.	1.00	Metals in Sediment	3B
0323.00	Trib. to Castile Cr.	1.20	Habitat Degradation	3B
0393.00	Trib. to Clear Cr.	2.20	Habitat Degradation	3B
0133.00	Trib. to Coon Cr.	2.00	Low Dissolved Oxygen	2B
0365.00	Trib to Crabapple Cr.	1.30	Habitat Degradation	3B
0254.00	Trib. to Davis Cr.	3.00	Habitat Degradation	3B
0415.00	Trib. to Edmondson Cr.	3.10	Habitat Degradation	3B
0374.00	Trib. to E. Fk. Crooked R.	4.80	Habitat Degradation	3B
0429.00	Trib. to E. Fk. L. Blue R.	1.90	Habitat Degradation	3B
0232.00	Trib. to High Cr.	2.00	Habitat Degradation	3B
3962.00	Trib. to L. Blue R.	5.90	Habitat Degradation	2B
0303.00	Trib. to Mill Cr.	1.80	Habitat Degradation	3B
2115.00	Trib. to Mineral Fk.	2.00	Metals in Sediment	2B
0411.00	Trib. to Missouri R.	5.30	Habitat Degradation	3B
0370.00	Trib. to Moss Cr.	0.50	Habitat Degradation	3B
0310.00	Trib. to Nichols Cr.	1.30	Habitat Degradation	3B
3261.00	Trib. to N. Indian Cr.	1.30	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
0281.00	Trib. to Nodaway R.	1.00	Habitat Degradation	3B
0314.00	Trib. to Prairie Cr.	1.00	Habitat Degradation	3B
2868.00	Trib. to Sweetwater Br.	1.00	Lead in Sediment	3B
0239.00	Tr. to O. Ch. Nishnabotna R.	0.90	Habitat Degradation	3B
0241.00	Tr. to O. Ch. Nishnabotna R.	2.00	Habitat Degradation	3B
0361.00	Turkey Cr.	4.70	Habitat Degradation	3B
0362.00	Turkey Cr.	3.50	Habitat Degradation	3B
0412.00	Van Meter Ditch	4.50	Habitat Degradation	3B
0360.00	Wakenda Cr.	29.20	Habitat Degradation	3B
0364.00	Wakenda Cr.	10.60	Habitat Degradation	3B
2136.00	Wallen Cr.	1.40	Aquatic Macroinvertebrate Bioassessments/Unkown	3B
1339.00	Walnut Cr.	2.30	Low Dissolved Oxygen	3B
7137.00	Walt Disney Lake	19.00	Chloride and Sulfate	2B
2374.00	Ward Br.	3.30	Bacteria, Aquatic Macroinvertebrate Bioassessments/Unknown, pH	3B
7087.00	Watkins Mill Lake	87.00	Bacteria	3B
7072.00	Waukomis Lake	76.00	Mercury and Chlordane in Fish Tissue	2B
0379.00	W. Fk. Crooked R.	6.60	Habitat Degradation	3B
0380.00	W. Fk. Crooked R.	9.80	Habitat Degradation	3B
3310.00	W. Fk. East Cr.	4.80	Habitat Degradation	2B
0929.00	W. Fk. Post Oak Cr.	12.80	Habitat Degradation	3B
0366.00	W. Fk. Wakenda Cr.	3.30	Habitat Degradation	3B
0367.00	W. Fk. Wakenda Cr.	7.80	Habitat Degradation	3B
1639.00	Whetstone Cr.	10.80	Fish Bioassessments/Unknown	2B
0230.00	W. High Cr.	2.80	Habitat Degradation	3B
0346.00	White Cloud Cr.	12.80	Habitat Degradation	3B
0259.00	Wildcat Cr.	4.00	Habitat Degradation	3B
0387.00	Williams Cr.	9.10	Habitat Degradation	3B
0381.00	Willow Cr.	6.50	Habitat Degradation	3B
7110.00	Worth County Community Lake	17.00	Chlorophyll	2B

0244.00	W. Tarkio Cr.	1.20	Habitat Degradation	3B
0246.00	W. Tarkio Cr.	9.60	Habitat Degradation	3B
0047.00	Wyaconda R.	42.20	Bacteria	2B



2018 303(d) List
Responses to Public Comments

Public Notice
July 1, 2017 – October 13, 2017

Missouri Department of Natural Resources
Water Protection Program
PO Box 176
Jefferson City, MO 65102-0176
800-361-4827 / 573-751-1300

Introduction

Pursuant to 40 CFR 130.7, States, Territories and authorized Tribes must submit biennially to the U.S. Environmental Protection Agency (USEPA) a list of water-quality limited (impaired) segments, pollutants causing impairment, and the priority ranking of waters targeted for Total Maximum Daily Load (TMDL) development. The Missouri Department of Natural Resources (department) placed the draft 2018 303(d) List of Impaired Waters on public notice from July 1, 2017 to October 13, 2017. All original comments received during this public notice period are available online on the department's website at <http://dnr.mo.gov/env/wpp/waterquality/303d/303d.htm>. Comments were received from the following groups or individuals:

- I. [Boone County](#)
- II. [City of Springfield](#)
- III. [City of Columbia](#)
- IV. [City of Rolla](#)
- V. [Kansas City Water Services](#)
- VI. [Missouri Public Utility Alliance \(MPUA\)](#)
- VII. [Missouri Municipal League](#)
- VIII. [LimnoTech](#)
- IX. [City of Wentzville](#)
- X. [Metropolitan St. Louis Sewer District \(MSD\)](#)
- XI. [Association of Missouri Cleanwater Agencies](#)
- XII. [HDR.Inc](#)
- XIII. [United States Environmental Protection Agency \(USEPA\) Region 7](#)
- XIV. [City of Independence](#)
- XV. [Dr. Barry Poulton](#)

This document summarizes and paraphrases the comments received, provides the department's responses to those comments, and notes any changes made to the final proposed 2018 303(d) List of Impaired Waters or supporting documentation. A priority ranking of impaired waters for TMDL development will be produced and placed on public notice following approval of the 2018 303(d) List by the Missouri Clean Water Commission.

Summary of department actions as a result of public comments

A. Waters removed from the Draft 2018 303(d) List (These water were not previously listed in 2016)

1. [Little Bonne Femme Creek \(WBID 1003\)](#) – Dissolved Oxygen
2. [Fenton Creek Tributary \(WBID 4120\)](#) – *Escherichia coli*
3. [Martigney Creek \(WBID 4109\)](#) – Chloride
4. [Straight Fork \(WBID 959\)](#) – *Escherichia coli*
5. [Grand Glaize Creek \(WBID 2184\)](#) – *Escherichia coli* SCR use only
6. [Gravois Creek \(WBID 1713\)](#) – *Escherichia coli* SCR use only

B. Additional Waters Proposed to De-listed.

1. [Wilsons Creek \(WBID 2375\)](#) – *Escherichia coli*
2. [Trib to Red Oak Creek \(WBID 3360\)](#) – Dissolved Oxygen
3. [Trib to Red Oak Creek \(WBID 3361\)](#) – Dissolved Oxygen
4. [Strother Creek \(WBID 2751\)](#) – Lead in water
5. [Strother Creek \(WBID 2751\)](#) – Lead in sediment
6. [Strother Creek \(WBID 2751\)](#) – Nickel in sediment
7. [Strother Creek \(WBID 2751\)](#) – Zinc in water
8. [Strother Creek \(WBID 2751\)](#) – Zinc in sediment
9. [Strother Creek \(WBID 3965\)](#) – Arsenic in sediment
10. [Strother Creek \(WBID 3965\)](#) – Lead in sediment
11. [Strother Creek \(WBID 3965\)](#) – Nickel in sediment
12. [Strother Creek \(WBID 3965\)](#) – Zinc in sediment
13. [Strother Creek \(WBID 3965\)](#) – Zinc in water
14. [Big Creek \(WBID 2916\)](#) – Lead in Sediment
15. [McCoy Creek \(WBID 214\)](#) – Dissolved Oxygen
16. [River des Peres \(WBID 1710\)](#) – Dissolved Oxygen
17. [Mattese Creek \(WBID 3596\)](#) – Chloride
18. [Creve Coeur Creek \(WBID 1703\)](#) – Dissolved Oxygen

C. Waters to be added to the Proposed 2018 303(d) List

1. [Big River \(WBID 2080\)](#) – Zinc in sediment
2. [Fenton Creek \(WBID 3595\)](#) – *Escherichia coli*
3. [West Fork Black River \(WBID 2755\)](#) – Zinc in water

D. Other Changes

1. [Peruque Creek \(WBID 218\)](#) – Cause changed from Fishes Bioassessments/Unknown to Aquatic Macroinvertebrate Bioassessments/Unknown.

Comments and Responses

I. Boone County comments

Little Bonne Femme Creek (WBID 1003)

Boone County requested that the department include more recent data collected by the department in 2017.

Department Response

The department incorporated the 2017 data into the assessment worksheet. This new data provided additional samples with DO measurements above 5 mg/l. Incorporating the additional data shows that the water no longer meets the Listing Methodology Document definition of an impaired water. The department will remove this water from the proposed 2018 303(d) list.

II. City of Springfield comments

Pearson Creek (WBID 2373)

The City of Springfield finds the biological impairment of Pearson Creek to be questionable based on inappropriate use of reference stream. Additionally, toxicity data provided by the City of Springfield provides strong evidence that there are no toxicity issues in Pearson Creek.

Department Response

Pearson Creek was originally placed in Category 5 during the 2002 assessment cycle due to reduced aquatic biodiversity caused by unknown toxicity. In 2011 a TMDL was developed by EPA, but this TMDL was challenged in court and was later vacated. During the 2014 listing cycle, the department requested the water body be removed from Category 5 and placed into Category 3B (i.e., available data suggested noncompliance but there is insufficient data to conduct a full assessment in accordance with the Listing Methodology Document) based on a public comment received from the City of Springfield that the aquatic macroinvertebrate community was inappropriately assessed against biological reference streams provided within Table I of Missouri's Water Quality Standards. EPA rejected the delisting of Pearson Creek because it was originally listed as impaired for a documented decline in biotic diversity due to unknown pollutants. This cause of impairment was not dependent upon an assessment of the state's Macroinvertebrate Stream Condition Index (MSCI) score procedure (<http://dnr.mo.gov/env/wpp/waterquality/docs/2014-epa-approval-memo.pdf>). Additional studies by the department have been conducted for biotic diversity in Pearson Creek. The diversity has improved, but still shows signs of declined biodiversity and potential habitat issues. See the department's latest study here: <http://dnr.mo.gov/env/esp/wqm/docs/PearsonCreekFY15BioReport.pdf>)

Department staff reviewed the toxicity information and agrees the data is promising with respect to water quality status of the creek. However, the data does not include corresponding sediment data to show the concentrations of PAHs, metals, or other toxins that were used for toxicity tests. These toxicity tests also do not address the biodiversity of the stream. Lacking this information the department would not be confident in recommending a de-listing decision.

Jordan Creek (WBID 3374)

The City of Springfield finds that the department's rationale for listing Jordan Creek as impaired does not meet the weight of evidence requirements outlined in the 2018 Listing Methodology Document (LMD). The draft list identifies Jordan Creek as impaired based upon sediment samples that exceeded the 150 percent of the Probable Effect Concentration (PEC) threshold for Polycyclic Aromatic Hydrocarbon (PAH) compounds. However, sediment data alone is not sufficient for listing Jordan Creek as impaired.

Department Response

Department staff reviewed the toxicity information and agrees the data is promising with respect to water quality status of the creek. However, the data does not include corresponding sediment data to show the concentrations of PAHs, metals, or other toxins that were used for toxicity tests. These toxicity tests also do not address the biodiversity of the stream. Lacking this information the department would not be confident in recommending a de-listing decision.

In reviewing the available data during the 2018 listing cycle, the Category 5 (303(d) List) decision was retained by the department. As stated, the geometric mean of sediment data was assessed following the 2018 LMD at 150 percent of the PEC thresholds for PAH compounds. The 150 percent PEC verses the 100 percent PEC threshold provides a conservative assessment of sediment toxicity and its potential for toxicity to aquatic life. In reviewing the sediment data collected in 2013, the geometric mean for the PAH compounds exceeded the 150 percent thresholds. Using 150% of the PECs allows for some unknown variability in regards to toxicity to aquatic life.

Wilsons Creek (WBID 2375)

The City of Springfield provided a comment on Wilsons Creek for polycyclic aromatic hydrocarbons (PAHs) based upon additional data resulting in a geometric mean less than 150 percent of the probable effect concentration (PEC) threshold. Additionally, toxicity data made available on EPA's Storage and Retrieval (STORET) website provides strong evidence that there are no toxicity issues in Wilsons Creek. In addition the city noted an error with the assessment worksheet and the listing for bacteria.

Department Response

Department staff reviewed the information and agrees the data is promising with respect to water quality status of the creek. However, the data does not include corresponding sediment data to show the concentrations of PAHs that were used for toxicity tests. Lacking this information the department would not be confident in recommending a de-listing decision.

The department agrees that there was an error with the proposed 2018 list to include Wilsons Creek as impaired for *Escherichia coli* (*E.coli*). The department will propose to delist Wilsons Creek (WBID 2375) for *E.coli*.

North Branch Wilsons Creek (WBID 3811)

The City of Springfield provided a comment stating it finds the department's supporting rationale for listing North Branch Wilsons Creek as impaired does not meet the weight of evidence requirements outlined in the 2016 LMD. North Branch Wilsons Creek is impaired for zinc based on sediment data that exceeds 150 percent of the PEC. Missouri's LMD states the department will use a weight of evidence analysis for evaluating all narrative criteria and in the case of toxic chemicals occurring in benthic sediment rather than water, the numeric thresholds used to determine the need for further evaluation will be the PEC. Accordingly, exceedances of PEC values should only be used to place water bodies in Category 3B of the LMD, or as part of the weight of evidence analysis. Without additional data or biological or toxicity data, there is insufficient evidence that North Branch Wilsons Creek is impaired. The city requests North Branch Wilsons Creek be delisted.

Department Response

The USEPA placed North Branch Wilsons Creek on the 2014 303(d) List for elevated zinc in sediment following the 2014 LMD approved by the Clean Water Commission on May 2, 2012. New information is not available and a lack of biological data does not provide good cause to delist the water. This water body will be prioritized for additional monitoring.

All Four Streams (Pearson, Jordan, Wilson, & North Branch Wilson)

The City of Springfield provided comments on the use of additional relevant physical and chemical data (ESBs, TOC ΣSEM-AVS/FOC/AVS, NIOCs). Additional comments were provided requesting the department to categorize all four streams as 5-alternative or 4B giving evidence of the City's IP and MOU as justification for giving low priority for TMDL development for these four streams.

Department Response

The use of the additional physical and chemical data is not addressed in the 2018 Listing Methodology Document. It is, however, addressed in the 2020 Listing Methodology Document. In the 2020 Listing Methodology Document, as well as during the biological workgroup and public availability meetings, the department discussed the use of this additional data, specifically the use of Total Organic Carbon (TOC). The department stated during the May 9th, 2017 meeting that the variability of TOC was too high, there is relatively little TOC data available, and additional information about the contaminant binding capacity relationship to organic carbon is not available (i.e. we don't know if there is a linear relationship throughout the full range of TOC). The department stands by its policy of not normalizing for TOC. See the department's responses to public comment on the proposed 2020 Listing Methodology Document for additional information. Additional chemical analysis procedures mentioned by the City of Springfield in their comment are addressed in the 2020 Listing Methodology Document.

For streams to be placed in Categories 5-alternative or 4B the department expects a watershed based approach will be used to ensure water quality standards are met in a timely fashion. In order to use the 5-alternative or 4B approach the appropriate information must be provided to the department that demonstrates that the approach used will be as or more effective than a TMDL. The department will have a public meeting on January 18, 2018 to discuss these items, and additionally will have further information posted on the 303(d) website about these requirements. Both will be available prior to and during the public notice of the department's TMDL priority list, which will occur after the Clean Water Commission approves the proposed 2018 303(d) List. The department will consider these comments when generating the draft TMDL priorities list.

III. City of Columbia comments

TMDL Priority for Columbia area impaired streams

The City of Columbia provided comments requesting the department to categorize Hinkson Creek (WBIDs 1007 & 1008), Hominy Branch (WBID 1011), Grindstone Creek (WBID 1009), Gans Creek (WBID 1004), and Little Bonne Femme Creek (WBID 1003) as 5-alternative or 4B giving evidence of the City's IMP as justification for giving low priority for TMDL development.

Department Response

For streams to be placed in Categories 5-alternative or 4B the department expects a watershed based approach will be used to ensure water quality standards are met in a timely fashion. In order to use the 5-alternative or 4B approach the appropriate information must be provided to the department that demonstrates that the approach used will be as or more effective than a TMDL.

The department will have a public meeting on January 18, 2018 to discuss these items, and additionally will have further information posted on the 303(d) website about these requirements. Both will be available prior to and during the public notice of the department's TMDL priority list, which will occur after the Clean Water Commission approves the proposed 2018 303(d) List. The department will consider these comments when generating the draft TMDL priorities list.

IV. City of Rolla comments

TMDL Priority for Rolla area impaired streams

The City of Rolla provided comments requesting the department to categorize Dutro Carter Creek (WBIDs 3569 & 3570), Burgher Branch (WBID 1865), Little Dry Fork (WBIDs 1863 & 1864), and Little Beaver Creek (WBID 1529) as 5-alternative or 4B giving evidence of the City's IMP as justification for giving low priority for TMDL development.

Department Response

For streams to be placed in Categories 5-alternative or 4B the department expects a watershed based approach will be used to ensure water quality standards are met in a timely fashion. In order to use the 5-alternative or 4B approach the appropriate information must be provided to the department that demonstrates that the approach used will be as or more effective than a TMDL. The department will have a public meeting on January 18, 2018 to discuss these items, and additionally will have further information posted on the 303(d) website about these requirements. Both will be available prior to and during the public notice of the department's TMDL priority list, which will occur after the Clean Water Commission approves the proposed 2018 303(d) List. The department will consider these comments when generating the draft TMDL priorities list.

V. Kansas City Water Services comments

TMDL Priority for Blue River Watershed impaired streams

The Kansas City Water Services provided comments requesting the department to categorize Blue River watershed impaired streams as 5-alternative or 4B giving evidence of the City's BRIWP as justification for giving low priority for TMDL development.

Department Response

For streams to be placed in Categories 5-alternative or 4B the department expects a watershed based approach will be used to ensure water quality standards are met in a timely fashion. In order to use the 5-alternative or 4B approach the appropriate information must be provided to the department that demonstrates that the approach used will be as or more effective than a TMDL.

The department will have a public meeting on January 18, 2018 to discuss these items, and additionally will have further information posted on the 303(d) website about these requirements. Both will be available prior to and during the public notice of the department's TMDL priority list, which will occur after the Clean Water Commission approves the proposed 2018 303(d) List. The department will consider these comments when generating the draft TMDL priorities list.

Brush Creek (WBID 3986)

The Kansas City Water Services provided comments regarding Brush Creek (WBID 3986) and the PAHs impairment. They cited lack of biological data as well as the use of procedures mentioned in the 2020 Listing Methodology Document, specifically the use of Total Organic Carbon (TOC) and Total PAHs.

Department Response

Brush Creek was originally put on the 2014 303(d) List by USEPA using our Listing Methodology Document at the time. Since Brush Creek has been listed previously, the department must show good cause to delist the stream. Lack of any biological data does not meet those requirements.

The 2018 draft list was generated using the protocols outlined in the 2018 Listing Methodology Document. Unfortunately, the department cannot use procedures from a Listing Methodology Document that has not been approved by the Clean Water Commission (i.e. 2020 Listing Methodology Document) to generate the current list. Also, within the 2020 Listing Methodology Document the department states that it will not normalize for TOC with the explanation presented in the 2020 Listing Methodology Document as well as at the May 9th, 2017 Biological Workgroup meeting.

VI. Missouri Public Utility Alliance (MPUA) comments

East Fork Locust Creek (WBID 608)

The MPUA provided comments regarding the E.coli impairment of East Fork Locust Creek and the source being identified as municipal point source discharges. The MPUA also added that the Milan WWTP has been upgraded to include UV disinfection and that this upgrade occurred after the data in the assessment worksheet, therefore the data in the assessment worksheet is no longer valid.

Department Response

The department appreciates the MPUA's comment. The assessment unit was not aware that the upgrade had occurred at the Milan WWTP facility. Unfortunately, without additional data that has been collected after the upgrade, the department cannot show that the impairment has been corrected and delist this stream. Because of this new information, the department will prioritize sampling to assess current stream conditions. The department will include this facility in our future QAPPs as resources allow.

Little Beaver Creek (WBID 1529)

The MPUA provided comments regarding the E.coli impairment of Little Beaver Creek and the source being identified as municipal point source discharges. The MPUA also added that the Rolla SW WWTP has been upgraded to include UV disinfection and that this upgrade occurred after the data in the assessment worksheet, therefore the data in the assessment worksheet is no longer valid.

Department Response

The department appreciates the MPUA's comment. The assessment unit was not aware that the upgrade had occurred at the Rolla SW WWTP. Unfortunately, without additional data that has been collected after the upgrade, the department cannot show that the impairment has been corrected and delist this stream. Because of this new information, the department will prioritize sampling to assess current stream conditions. The department will include this facility in our future QAPPs as resources allow.

VII. Missouri Municipal League comments

Humansville WWTP – Brush Creek (WBID 1371)

The Missouri Municipal League believes the current conditions of the stream have improved since the time the data was collected, therefore the data used for assessment is no longer valid.

Department Response

The department agrees the data used for assessment is old. The department will investigate when the last time the treatment plant was upgraded. If the facility has been upgraded to address the impairment, the department will prioritize sampling on Brush Creek (WBID 1371). Unfortunately, without evidence of an upgraded facility as well as data collected after the upgrade, the department cannot show that the impairment has been corrected and delist this stream. The department will include this facility in our future QAPPs as resources allow.

Monett WWTP – Clear Creek (WBID 3239)

The Missouri Municipal League believes the current conditions of the stream have improved since the time the data was collected, therefore the data used for assessment is no longer valid.

Department Response

The department agrees the data used for assessment is old. The department will investigate when the last time the treatment plant was upgraded. If the facility has been upgraded to address the impairments, the department will prioritize sampling on Clear Creek (WBID 3239).

Unfortunately, without evidence of an upgraded facility as well as data collected after the upgrade, the department cannot show that the impairment has been corrected and delist this stream. The department will include this facility in our future QAPPs as resources allow.

Owensville WWTP – Red Oak Creek and Tributary to Red Oak Creek (WBIDs 2038, 3360 & 3361)

The Missouri Municipal League provided comments that the current assessment does not follow the 2018 Listing Methodology Document protocol and should be re-assessed.

Department Response

The department agrees that the waters needed to be re-assessed. In doing so, the department has determined that the Tributary to Red Oak Creek (WBIDs 3360 & 3361) should be delisted. Red Oak Creek will remain on the 2018 303(d) list and the assessment worksheet has been updated on the department's 303(d) website. The department is currently collecting more data on Red Oak Creek and will re-assess this water during the 2020 assessment cycle.

Montgomery City East WWTF – Elkhorn Creek (WBID 189)

The Missouri Municipal League believes the current conditions of the stream have improved since the time the data was collected, therefore the data used for assessment is no longer valid.

Department Response

The department agrees some of the data used for assessment is old. The last time the treatment plant was upgraded was in 2012. The department will prioritize future sampling on Elkhorn Creek (WBID 189). Unfortunately, without data collected after the facility upgrade, the department cannot show that the impairment has been corrected and delist this stream. The department will include this facility in our future QAPPs as resources allow.

Versailles WWTF – Straight Fork (WBID 959)

The Missouri Municipal League provided comments regarding the E.coli impairment of Straight Fork. The Missouri Municipal League asks that the new 2018 listing be held off until more data is collected since the Versailles WWTF was upgraded in 2016 and UV disinfection was installed and went online in June of 2015.

Department Response

The department agrees that since the listing for this water is new this cycle, the listing is inappropriate given that it is not representative of current conditions. The Versailles WWTF was upgraded in 2016 to include UV disinfection of its effluent. Also, the most recent monthly DMRs (May –October of 2017) show the WWTF is meeting its permit limits as well as Water Quality Standards for *Escherichia coli*. The department will remove Straight Fork from the proposed 2018 303(d) list for *Escherichia coli* and will prioritize the water for future monitoring to ensure instream water quality is being maintained. Straight Fork will remain on the proposed 2018 303(d) list for low dissolved oxygen until further data is collected. The department will include this facility in our future QAPPs as resources allow.

VIII. LimnoTech comments

Courtois Creek (WBID 1943)

LimnoTech provided comments that a treatment plant for the Doe Run Viburnum facility was constructed and became operational in October of 2016. A previous discharge to a tributary of Indian Creek was also eliminated. This facility discharges into Indian Creek, which flows into Courtois Creek. LimnoTech also provided data for one sediment chemistry sample collected in September of 2017. LimnoTech requested that Courtois Creek be delisted.

Department Response

The department appreciates the information on the updated facility and the submittal of QA acceptable data from LimnoTech. This allows the department to have evidence to stratify the data. Unfortunately, only one sample was collected and the department needs at least three samples to make an assessment for sediment. Not stratifying the data still leads to a geometric mean above 150% of the PEC value for lead. The new data looks promising, but until more data is collected or received, Courtois Creek will remain on the proposed 2018 303(d) list. The department will include this stream in our future QAPPs as resources allow. The department is willing to continue working with third parties for data collection in a timelier manner.

Indian Creek (WBID 1946)

LimnoTech provided comments that a treatment plant for the Doe Run Viburnum facility was constructed and became operational in October of 2016. A previous discharge to a tributary of Indian Creek was also eliminated. This facility discharges into Indian Creek, which flows into Courtois Creek. LimnoTech also provided data for one sediment chemistry sample and one water chemistry sample both collected in September of 2017. LimnoTech requested that Indian Creek be delisted.

Department Response

The department appreciates the information on the updated facility and the submittal of QA acceptable data from LimnoTech. This allows the department to have evidence to stratify the data. Unfortunately, only one sample for each media type (water and sediment) was collected and the department needs at least three samples to make an assessment for sediment. Not stratifying the sediment data still leads to a geometric mean above 150% of the PEC value for lead. The department also needs more than one water sample to assess against Water Quality Standards. The new data looks promising, but until more data is collected or received, Indian Creek will remain on the proposed 2018 303(d) list for lead and zinc in sediment. There is a TMDL for lead and zinc in water, so Indian Creek will not appear on the proposed 2018 303(d) list for those pollutants. The department will include this stream in our future QAPPs as resources allow. The department is willing to continue working with third parties for data collection in a timelier manner.

Crooked Creek (WBID 1928)

LimnoTech provided comments that discharges for the Casteel Mine were eliminated in May of 2016 and the discharges for the BRRF were eliminated in March of 2016. LimnoTech also provided data for one sediment chemistry sample collected in September of 2017. LimnoTech requested that Crooked Creek be delisted.

Department Response

The department appreciates the information on the elimination of discharges and the submittal of QA acceptable data from LimnoTech. This allows the department to have evidence to stratify the data. Unfortunately, only two samples were collected since the elimination of discharges and the department needs at least three samples to make an assessment for sediment. Not stratifying the data still leads to a geometric mean above 150% of the PEC value for cadmium and above the PEC for lead. The new data looks promising, but until more data is collected or received, Courtois Creek will remain on the proposed 2018 303(d) list. The department will include this stream in our future QAPPs as resources allow. The department is willing to continue working with third parties for data collection in a timelier manner.

Strother Creek (WBID 2751 & 3965)

LimnoTech provided comments that a new treatment plant was constructed at the Doe Run Buick Mine facility, which discharges into Strother Creek. The new plant began operation in November of 2015. LimnoTech also provided two water chemistry sample and six sediment chemistry samples (including one duplicate sample) all collected in September of 2017. LimnoTech requested that Strother Creek be delisted.

Department Response

The department appreciates the information on the updated facility and the submittal of QA acceptable data from LimnoTech. This allows the department to have evidence to stratify the data. The new data provides enough information to show that Strother Creek (WBIDs 2751 & 3965) is no longer impaired for arsenic, nickel, lead, and zinc in sediment. With the elimination of the outfall, the reduction in sediment contamination, as well as water samples showing levels meeting Water Quality Standards, the department believes this shows that Strother Creek (WBIDs 2751 & 3965) is no longer impaired for lead and zinc in water. The department will propose to delist Strother Creek (WBIDs 2751 & 3965) from the 2018 303(d) list for lead in water and sediment, arsenic in sediment, nickel in sediment, and zinc in water and sediment.

Bee Fork (WBID 2760)

LimnoTech provided comments that Doe Run previously discharged to Bee Fork from the Fletcher Mine and Mill facility, but the discharge was eliminated in December of 2016. LimnoTech also provided one water chemistry sample collected in September of 2017. LimnoTech requested that Bee Fork be delisted.

Department Response

The department appreciates the information on the removal of a discharge and the submittal of QA acceptable data from LimnoTech. This allows the department to have evidence to stratify the data. Unfortunately, only one sample was collected and the department needs at least three samples to make an assessment for water. The new data looks promising, but until more data is collected or received, Bee Fork will remain on the proposed 2018 303(d) list. The department will include this stream in our future QAPPs as resources allow. The department is willing to continue working with third parties for data collection in a timelier manner.

Big Creek (WBID 2916)

LimnoTech provided two water chemistry samples and three sediment chemistry samples (one duplicate) all collected in September of 2017. LimnoTech requested that Big Creek be delisted.

Department Response

The department appreciates the submittal of QA acceptable data from LimnoTech. Because no information was provided that would allow the department to stratify the data, the department must consider this data with the previous data collected. Re-assessment including the data provided by LimnoTech resulted in a sediment lead geometric mean below the 150% PEC threshold. The sediment cadmium geometric mean was still above the 150% PEC threshold. Big Creek has a TMDL for cadmium, lead, and zinc. Because these pollutants have TMDLs, they do not appear on the 303(d) list. The new data still shows chronic exceedances for cadmium and lead. The department will propose to delist Big Creek for lead in sediment. Big Creek will remain on the proposed 303(d) list for cadmium in sediment. Big Creek will also remain in Category 4A for cadmium and lead in water.

IX. City of Wentzville Comments

McCoy Creek (WBID 214)

The City of Wentzville provided comments that a 319 project ended in 2015 to do improvements to the Dry Branch watershed. Dry Branch enters into McCoy Creek just upstream of where the data for the assessment was collected. The most recent data collected in 2016 shows improvement in water quality.

Department Response

The department appreciates the information regarding the completion date of the project. Additionally, the department notes the Wentzville Water Reclamation Plant underwent upgrades in 2014-2015 which would allow stratifying the data. The department concurs that the 2016 data shows no exceedances of the dissolved oxygen criterion as well as a reduction in the average amount of nutrients. The department will propose to delist McCoy Creek from the 2018 303(d) list.

Peruque Creek (WBID 218)

The City of Wentzville provided comments that the older data is no longer representative of current conditions and Peruque Creek should be delisted for low dissolved oxygen (DO). The City also requested clarification on the Fishes Bioassessments/ Unknown listing, noting that biological data was not present in the assessment worksheet.

Department Response

The department updated the assessment worksheet to include biological data. The most recent biological study in 2014-2015 showed DO issues as well as a complete lack of *plecoptera* from the invertebrate samples. This study also compared the recent data to the 2002 data and showed lower scores for the more recent data. Peruque Creek will remain on the proposed 2018 303(d) list for low dissolved oxygen and, the department will change the listing from Fishes Bioassessments/Unknown to Aquatic Macroinvertebrate Bioassessments/Unknown.

X. Metropolitan St. Louis Sewer District (MSD) comments

1. Bacteria Data Qualifiers

MSD provided comments requesting clarification of the use of data qualifiers in regards to bacteria and other data.

Department Response

The department appreciates the comment from MSD. This topic has been discussed in past public meetings, and because the clarifications would not constitute changes to the actual methods of assessment, the department will clarify how data qualifiers are handled for assessments in the proposed 2020 Listing Methodology Document. Please consult that document for further information and details.

2. Assessment Worksheets Linked in 303(d) list/Sorting

MSD provided comments that they would like to have links to the assessment worksheets available in the 303(d) list as well as sorting in a more efficient manner.

Department Response

The department appreciates the feedback on the organization of, and the access to, the data. The department will continue to work on making the data more user friendly.

3. Fenton Creek tributary (WBID 4119)

MSD provided comments that one bacteria result is causing the exceedance of the Secondary Contact Recreation use. Additionally MSD provided comments that the samples were collected during elevated flows.

Department Response

The department does not agree that the sample collected on 5/11/2015 is driving the exceedance of the secondary contact use. Five of the seven samples exceed the WQS criterion for secondary contact use. Additionally, the occurrence of elevated flow should not discount the validity of the data. The use should still be protective during times when recreation can reasonably be assumed to occur. Flood or peak flow (flows exceeding 95th percentile flow) conditions would be an example of where it would be unreasonable to assume the use could occur (physical safety concerns outweigh human health concerns). Fenton Creek Tributary (WBID 4119) will remain on the proposed 2018 303(d) list.

4. Fenton Creek tributary (WBID 4120)

MSD provided comments that one bacteria result is causing the exceedance of the Whole Body Contact Recreation use. Additionally MSD provided comments that the samples were collected during elevated flows.

Department Response

The department agrees that the sample collected on 5/11/2015 is driving the exceedance of the whole body contact use. However, the occurrence of elevated flow should not discount the validity of the data. The use should still be protective during times when recreation can reasonably be assumed to occur. Flood or peak flow (flows exceeding 95th percentile flow) conditions would be an example of where it would be unreasonable for the use to occur (physical safety concerns outweigh human health concerns). Fenton Creek Tributary (WBID 4120) will be removed from the proposed 2018 303(d) list and placed into category 2B, with priority added for additional monitoring in the future.

5. Grand Glaize Creek (WBID 2184)

MSD provided comments that one bacteria result is causing the exceedance of the Secondary Contact Recreation use, additionally this sample was collected during elevated flows.

Department Response

The department agrees that the sample collected on 5/17/2015 is driving the exceedance of the secondary contact use. However, the occurrence of elevated flow should not discount the validity of the data. The use should still be protective during times when recreation can reasonably be assumed to occur. Flood or peak flow (flows exceeding 95th

percentile flow) conditions would be an example of where it would be unreasonable to assume the use could occur (physical safety concerns outweigh human health concerns). Grand Glaize Creek (WBID 2184) will be removed from the proposed 2018 303(d) list for the Secondary Contact Recreation use, but will remain on the proposed 2018 303(d) list for impairment of the Whole Body Contact Recreation use.

6. Gravois Creek (WBID 1713)

MSD provided comments that one bacteria result is causing the exceedance of the Secondary Contact Recreation use, additional this sample was collected during elevated flows.

Department Response

The department agrees that the sample collected on 4/22/14 is driving the exceedance of the secondary contact use. However, the occurrence of elevated flow should not discount the validity of the data. The use should still be protective during times when recreation can reasonably be assumed to occur. Flood or peak flow (flows exceeding 95th percentile flow) conditions would be an example of where it would be unreasonable to assume the use could occur (physical safety concerns outweigh human health concerns). Gravois Creek will be removed from the proposed 2018 303(d) list for the Secondary Contact Recreation use, but will remain on the proposed 2018 303(d) list for impairment of the Whole Body Contact Recreation use.

7. Little Antire Creek (WBID 4115)

MSD provided comments that one bacteria result is causing the exceedance of the Secondary Contact Recreation use. Additionally MSD provided comments that the samples were collected during elevated flows.

Department Response

The department agrees that the sample collected on 5/17/2016 could be driving the exceedance of the secondary contact use. However, the occurrence of elevated flow should not discount the validity of the data. The use should still be protective during times when recreation can reasonably be assumed to occur. Flood or peak flow (flows exceeding 95th percentile flow) conditions would be an example of where it would be unreasonable to assume the use could occur (physical safety concerns outweigh human health concerns). This was not the case for Little Antire Creek. Little Antire Creek will

remain on the proposed 2018 303(d) list for impairment of the Whole Body Contact Recreation use.

8. Martigney Creek (WBID 4109)

MSD provided comments that there were some errors in assessing the hydrologic condition of the stream when the samples were taken. MSD also supplied additional 2016 and 2017 chloride data. Based on the errors and new data Martigney Creek should be delisted for chloride.

Department Response

The department agrees that some errors were made in assessing the hydrologic condition of the stream when samples were taken. Daily average flows were looked at instead of instantaneous values. When considering the instantaneous values for all of the potential chronic and acute WQS exceedances, there was still one acute exceedance and four chronic exceedances, mostly in 2014. The department re-assessed the stream given the new data. Since 2014 is no longer in the last three years of available data, 2014 data is no longer available for consideration. For the 2015-2017 period, there was only one chronic chloride exceedance during stable flow conditions. As a result of this re-assessment, the department will remove Martigney Creek from the proposed 2018 303(d) list.

9. River des Peres tributary (WBID 4111)

MSD provided comments that there were some errors in assessing the hydrologic condition of the stream when the samples were taken. Based on the errors and new data River des Peres should be delisted for chloride.

Department Response

The department agrees that some errors were made in assessing the hydrologic condition of the stream when samples were taken. Daily average flows were looked at instead of instantaneous values. When considering the instantaneous values for all of the potential chronic and acute WQS exceedances, there was still one acute exceedance and six chronic exceedances in the last three years of available data. The department re-assessed the stream given the new data. The River des Peres tributary will remain on the proposed 2018 303(d) list.

10. Gravois Creek (WBID 1712)

MSD provided comments that the geometric mean was not correctly calculated. MSD asked that only the parent of the duplicate be used for assessment. MSD also provided comments that only one acute and one chronic exceedance occurred in the last three years of available data. Thus Gravois Creek should be delisted for chloride.

Department Response

The department agrees that the geometric mean for 2013 was incorrect. However, the corrected geometric mean is still above the Whole Body Contact Recreation criterion. The department stands by the averaging of field duplicate samples. Although the purpose of the duplicate samples is for quality assurance purposes, that does not make the sample results any less valid. In order to not count the one sampling event as two distinct samples (and thereby potentially have two distinct exceedances), the department averages the duplicate samples because they are both representative of conditions in the stream. Gravois Creek (WBID 1712) will remain on the proposed 2018 303(d) list for *E.coli*.

The two toxicity events are of the same parameter and separated by a year. These are two distinct toxic events caused by the same pollutant. Due to being two distinct events for the same pollutant, Gravois Creek (WBID 1712) will remain on the proposed 2018 303(d) list.

11. Mattese Creek (WBID 3596)

MSD provided comments that only one acute and one chronic exceedance occurred in the last three years of available data. MSD also provided additional data from 2016 and 2017. Thus Mattese Creek should be delisted for chloride.

Department Response

The department appreciates the additional data on Mattese Creek. The department reassessed the stream using the additional data and notes there was only one exceedance of the chronic WQS for chloride during stable conditions in the last three years of available data. The department will therefore propose Mattese Creek (WBID 3596) be delisted for chloride.

12. Creve Coeur Creek (WBID 1703)

MSD provided comments that there were some errors in the assessment worksheet.

Department Response

The department appreciates Metropolitan St. Louis Sewer District finding these errors and the worksheet was lacking hydrologic codes. The department re-assessed the water after updating the worksheet and notes there were still two samples where chronic chloride exceedances occurred during stable flow. Creve Coeur Creek will remain on the proposed 2018 303(d) list.

13. Tributary to Gravois Creek (WBID 4051)

MSD provided comments that two samples look to be duplicates and need to be averaged or only use the parent sample.

Department Response

The department agrees that the two samples are duplicates and should have been averaged for the assessment. The department re-assessed the water after averaging the duplicates and notes the geometric mean is still above the criterion for Whole Body Contact Recreation. See response to number 10 above for use of parent samples only for assessment purposes. Gravois Creek Tributary (WBID 4051) will remain on the proposed 2018 303(d) list.

14. Fee Fee Creek (WBID 1704)

MSD provided comments that they would like to have the “(new)” removed from the water body name. Also the worksheet is missing hydrologic codes.

Department Response

The department will log the request to change the stream name in the WQS, but the change will have to be made in a future rulemaking. The missing hydrologic codes can be added to the assessment worksheet for clarity, but doing so will not change the assessment since there was more than one acute criterion exceedance for chloride. Fee Fee Creek (WBID 1704) will remain on the proposed 2018 303(d) list for chloride.

15. Antire Creek (WBID 2188) and Bonhomme Creek (WBID 1701)

MSD agrees with the delisting of Antire Creek and Bonhomme Creek. MSD also submitted comments in regards to watershed improvement projects.

Department Response

The department appreciates the comments and will make sure this information is transmitted to other program staff involved in watershed improvement efforts.

16. Creve Coeur Creek (WBID 1703)

MSD provided comments that older data is no longer representative due to watershed improvement projects. MSD also provided additional 2017 data and information regarding the removal of bypasses and the repair or replacement of sewer pipe in the Creve Coeur Creek watershed.

Department Response

The department appreciates the additional information provided by MSD. Due to the extensive pipeline work and the removal of bypasses, the department re-assessed the water using 2010-2017 data. The re-assessment shows that water quality is improving in Creve Coeur Creek and that it no longer meets the Listing Methodology Document definition of an impaired stream. The department will propose to delist Creve Coeur Creek for low dissolved oxygen.

17. River des Peres (WBID 1710)

MSD provided comments that older data is no longer representative due to watershed improvement projects. MSD also provided comments that some of the dissolved oxygen data they collected was during flood/backwater conditions and is not representative.

Department Response

The department agrees that dissolved oxygen readings taken during backwater conditions from the Mississippi River are not representative of conditions in River des Peres. After removing those samples identified as collected during backwater conditions, the department re-assessed the water and has determined that River des Peres is no longer impaired for low dissolved oxygen. The department will propose to delist River des Peres (WBID 1710) for dissolved oxygen. River des Peres (WBID 1710) will remain on the proposed 2018 303(d) list for *Escherichia coli*.

XI. Association of Missouri Cleanwater Agencies

Assessment Worksheets

The Association of Missouri Cleanwater Agencies made a comment during the October 4th Clean Water Commission Hearing thanking the department for preparing assessment worksheets for each new proposed water that is going to be added to the 2018 303(d) list, and for providing transparency to the listing process.

Department Response

The department appreciates the comment.

XII. HDR.Inc

Move waters to a low priority for TMDL development

HDR, Inc made comments during the October 4th Clean Water Commission Hearing on behalf of several clients. HDR's comments were in regards to Integrated Watershed Planning and TMDL priorities on multiple listed waters.

Department Response

For streams to be placed in Categories 5-alternative or 4B the department expects a watershed based approach will be used to ensure water quality standards are met in a timely fashion. In order to use the 5-alternative or 4B approach the appropriate information must be provided to the department that demonstrates that the approach used will be as or more effective than a TMDL. The department will have a public meeting on January 18, 2018 to discuss these items, and additionally will have further information posted on the 303(d) website about these requirements. Both will be available prior to and during the public notice of the department's TMDL priority list, which will occur after the Clean Water Commission approves the proposed 2018 303(d) List. The department will consider these comments when generating the draft TMDL priorities list.

XIII. United States Environmental Protection Agency (USEPA) Region 7

Big River (WBID 2080)

USEPA provided comments that zinc was not included in the TMDL cited by the state for this segment.

Department Response

The department appreciates USEPA pointing out this oversight. While implementation of the Big River TMDL for other metals from similar sources should also correct the zinc impairment, the department acknowledges it must retain the impairment on the 303(d) list. The department looks forward to working with EPA on a TMDL amendment or Category 5-alt listing for this water body pollutant pair. The department will restore the listing on the 303(d) list.

Fenton Creek (WBID 3595)

USEPA provided comments that the state's assessment spreadsheet and data both identify this segment as impaired by Escherichia coli.

Department Response

After reviewing the assessment spreadsheet, the department agrees this water should be maintained on the list. The department made an error in delisting this stream and will restore this listing on the 303(d) list.

Locust Creek (WBID 606)

USEPA provided comments that the delisting sheet identifies this water body as being proposed for delisting aquatic macroinvertebrate bioassessment/unknown. It did not appear as impaired under Section 303(d) on the 2016 Missouri list for aquatic macroinvertebrate bioassessment, only for Escherichia coli, for which it remains proposed for listing by the state in 2018.

Department Response

The department appreciates the clarification and comment. The department has determined that this was a record keeping error made by the department which has been subsequently corrected.

Peruque Creek (WBID 217)

USEPA provided comments that the delisting rationale does not include any data supporting the lack of sedimentation in this segment. For this delisting to be supported, submit the MDNR (2002) study and any sediment data supporting proposed delisting.

Department Response

The department will submit the report with the data included in support of the proposed delisting.

Shoal Creek (WBID 3230)

USEPA provided comments that the delisting sheet identifies this water body as being proposed for delisting fecal coliform. It did not appear as impaired under Section 303(d) on the 2016 Missouri list. The EPA approved a bacteria TMDL for this segment in 2007.

Department Response

The department appreciates USEPA providing this clarification. This was also a change in the pollutant. Shoal Creek has an approved TMDL for bacteria based on the original listing for fecal coliform. The department collected additional E.coli data and is changing the pollutant to E.coli, but the TMDL still addresses the pollutant of concern.

Strother Creek (WBID 2751)

USEPA provided comments that this delisting was not identified on the delisting worksheet. Is the aquatic macroinvertebrate delisting rationale the same as for Salt Pine Creek (2113), in that a specific pollutant(s) is taking the place of the biological listing?

Department Response

The department presumes the invertebrate community is impaired due to the pollutants already listed and are removing this cause until the metals pollutants are corrected. Once corrected, the department will re-assess the invertebrate community status, and if still impaired the department will place this water on the list for an impaired invertebrate community. The macroinvertebrate worksheet will be maintained as additional evidence that the listed pollutants are having adverse effects on the aquatic community.

West Fork Black River (WBID 2755)

USEPA provided comments pointing out that water chemistry data from site 2755/22.4 showed three exceedances for the acute zinc criterion. Acute WQS must be met in the mixing zone [10 CSR 20-7.030(5)4.A]. This water body should be added to the 303(d) list for zinc in water as the criteria was exceeded more than once in the last three years for which data is available.

Department Response

The USEPA is correct that the three samples collected in 2014 at site 2755/22.4 exceeded the acute criterion. As noted in the regulation cited above, mixing zone samples must meet acute criteria. As a result of this assessment, the department will place WBID 2755 on the proposed 2018 303(d) list for zinc in water.

XIV. City of Independence

Bacteria Worksheets

The City of Independence provided comments on some erroneous values in a few of the bacteria worksheets in the Independence area.

Department Response

The department appreciates the City of Independence finding and submitting comments on these errors. The errors have been corrected in the bacteria worksheets. The department notes, however, that none of these errors caused an inappropriate listing nor did the correction of these errors cause a listing to change.

XV. Dr. Barry Poulton

Hinkson Creek (WBIDs 1007 & 1008)

Dr. Barry Poulton provided comments asking to the department to consider adding Hinkson Creek (WBIDs 1007 & 1008) to the proposed 2018 303(d) list for Dissolved Oxygen and Chloride based on two articles published in 2017 on Hinkson Creek.

Department Response

The department appreciates Dr. Poulton bringing these journal articles and new data to our attention. The department reviewed the journal articles in response to this comment and notes that – 1) the state’s Dissolved Oxygen standards were not correctly referenced or interpreted, and 2) the articles did not provide enough data for the department to conduct an assessment following our Listing Methodology Document. The department reached out to the lead author and primary researcher, Dr. Jason Hubbard, and requested the data used in these studies. Dr. Hubbard declined to share the data from the published articles. Since the department does not have access to the data, an assessment following the state’s LMD cannot be conducted at this time. As soon as the data is made available, the department can conduct an assessment for these criteria.



2018 303(d) List
Responses to Public Comments
Received During the Second Public Notice Period

Second Public Notice Period
April 24 – July 23, 2018

Missouri Department of Natural Resources
Water Protection Program
PO Box 176
Jefferson City, MO 65102-0176
800-361-4827 / 573-751-1300

Introduction

Pursuant to 40 CFR 130.7, States, Territories and authorized Tribes must submit biennially to the U.S. Environmental Protection Agency (EPA) a list of water-quality limited (impaired) segments, pollutants causing impairment, and the priority ranking of waters targeted for total maximum daily load (TMDL) development. The Missouri Department of Natural Resources placed the draft 2018 303(d) List of Impaired Waters on public notice a second time from April 24 to July 23, 2018. All original comments received during this public notice period are available online on the Department's website at dnr.mo.gov/env/wpp/waterquality/303d/303d.htm. Comments were received from the following groups:

- I. [U.S. Environmental Protection Agency \(EPA\), Region 7](#)
- II. [City of Columbia](#)
- III. [City of Humansville](#)
- IV. [City of Rolla](#)
- V. [City of Springfield](#)
- VI. [Clarence Cannon Wholesale Water Commission](#)
- VII. [Doe Run Resource Corporation](#)
- VIII. [Kansas City Water Services](#)

This document summarizes and paraphrases the comments received, provides the Department's responses to those comments, and notes any changes made to the final proposed 2018 303(d) List of Impaired Waters or supporting documentation. The priority ranking of impaired waters for TMDL development will be amended as noted in the comment responses.

Summary of Department actions as a result of public comments

A. Waters to be added or re-added to the Proposed 2018 303(d) List

- 1. [Wilsons Creek \(WBID 2375\)](#) – *Escherichia coli*

B. Waters Proposed to be Delisted from the 2018 303(d) List

- 1. [West Fork Black River \(WBID 2755\)](#) – Zinc in water

C. Other Changes to the Proposed 2018 303(d) List

- 1. [Little Beaver Creek \(WBID 1529\)](#) – Source changed from municipal point sources to Source Unknown

Comments and Responses

I. U.S. Environmental Protection Agency (EPA), Region 7

Tributary to Fenton Creek (WBID 4120)

EPA provided comments that “The state omitted the water body cause of Escherichia coli from its submittal. The state had assessed this water body after excluding one data point because it was collected at a flow of greater than the 95th percentile. Under the state’s EPA-approved water quality standards there is no exclusion of data for high flow.”

*“10 CSR 20-7.031 (5)(C) Bacteria. The protection of whole body contact recreation is limited to waters designated for that use. The recreational season is from April 1 to October 31. **The E. coli count shall not exceed the criterion listed in Table A as a geometric mean during the recreational season in waters designated for whole body contact recreation.** The E. coli count shall not exceed one hundred twenty-six (126) per one hundred milliliters (100 mL) at any time in losing streams. For waters designated for secondary contact recreation, the E. coli count shall not exceed one thousand one hundred thirty-four (1,134) per one hundred milliliters (100 mL) as a geometric mean during the recreational season. [emphasis added]”*

Department Response

The Department maintains that the 2018 listing Methodology Document allows for the determination whether samples are collected under representative conditions. The Department believes the sample collected on May 11, 2015, was not collected under representative conditions. The Department will prioritize Tributary to Fenton Creek for additional data collection. No changes to the proposed 303(d) list were made as a result of this comment.

Wilsons Creek (WBID 2375)

EPA provided comments “The state proposed delisting the water body cause of Escherichia coli from its submittal. The state had assessed this water body under the Primary Contact Class B E. coli criterion. Under the state’s EPA-approved water quality standards this water body is a losing stream and so a different criterion is applicable.”

*“10 CSR 20-7.031 (5)(C) Bacteria. The protection of whole body contact recreation is limited to waters designated for that use. The recreational season is from April 1 to October 31. The E. coli count shall not exceed the criterion listed in Table A as a geometric mean during the recreational season in waters designated for whole body contact recreation. **The E. coli count shall not exceed one hundred twenty-six (126) per one hundred milliliters (100 mL) at any time in losing streams.** For waters designated for secondary contact recreation, the E. coli count shall not exceed one thousand one hundred thirty-four (1,134) per one hundred milliliters (100 mL) as a geometric mean during the recreational season. [emphasis added]”*

Department Response

The Department reassessed Wilsons Creek using additional data collected by the Green County Health Department, which further substantiates EPA's comments. An updated assessment worksheet will be available on the Department's 303(d) website and as an appendix to this response document (see Appendix A). Wilsons Creek will be maintained on the 2018 303(d) list as impaired for *Escherichia coli*. Since this impairment is not currently prioritized for TMDL development it will be given a priority of medium with a schedule of 2024-2028.

II. City of Columbia

TMDL Priority for Columbia area impaired streams

The City of Columbia provided comments regarding the City's draft integrated management plan (IMP) and the Department's reprioritization of TMDL development on the following impaired streams: Hinkson Creek (WBID 1007 & 1008), Hominy Branch (WBID 1011), Grindstone Creek (WBID 1009), Gans Creek (WBID 1004), and L. Bonne Femme Creek (WBID 1003). The City recognized the current prioritization of these waters by the department and intends to work with the Department to further refine TMDL prioritization using the IMP when finalized.

Department Response

The Department appreciates the City's comments and work to improve water quality through integrated planning. The Department looks forward to continued cooperation with the City and further clarification of how the Integrated Management Plan will lead to attainment of the impaired streams referenced in their comments. Additional information regarding scheduled improvements over time that will lead to water quality improvement would allow the Department to lower the priority of TMDLs for these waters even further. Prioritization for TMDL development will be reevaluated during the 2020 303(d) listing cycle using any new information provided by the City at that time.

III. City of Humansville

Brush Creek (WBID 1371)

The City of Humansville requested additional clarification and data on why the City is still being listed as the source of impairment for Brush Creek (WBID 1371), which is listed as impaired for dissolved oxygen.

Department Response

The City of Humansville waste water treatment plant is a three cell partially aerated lagoon. No major operational changes or upgrades have been made since the latest data collected in July 2016. The Department recognizes efforts by the City to reduce inflow and infiltration. These efforts, while beneficial to facility operations, have not changed the low dissolved oxygen problems observed in Brush Creek. The Department has sent the City the most recent assessment worksheet and wasteload allocation study report via email. The worksheet and report indicate

that the low dissolved oxygen impairment in Brush Creek downstream of the City's wastewater treatment facility has not been resolved. If the City has made facility upgrades that improve effluent quality, or if the City wishes to collect additional instream data to be used for future assessments, please contact Mr. Robert Voss, Monitoring & Assessment Unit Chief, at 573-522-4505 or by email at robert.voss@dnr.mo.gov. This information could be useful in reassessing the water body during future listing cycles. If the City would like to explore financial assistance options to upgrade the existing waste water treatment plant, please contact Mrs. Joan Doerhoff, Financial Assistance Center, at 573-526-0940 or by email at joan.doerhoff@dnr.mo.gov.

IV. City of Rolla

Little Beaver Creek (WBID 1529)

The City of Rolla requested the Department change the source of the Escherichia coli impairment on Little Beaver Creek (WBID 1529) from municipal point sources to unknown source.

Department Response

The Department concurs that the City of Rolla's Southwest wastewater treatment plant is the only permitted discharger of domestic wastewater to the stream. The facility currently disinfects its effluent and discharge monitoring report data demonstrates compliance with existing permit limits for bacteria. Therefore, the Department agrees a source change for this listing is appropriate. Little Beaver Creek (WBID 1529) will remain on the 2018 303(d) List, but the source will be changed to Source Unknown. The Department will prioritize Little Beaver Creek for additional data collection.

V. City of Springfield

The City of Springfield requested that the Department lower the TMDL development priority for Jordan Creek (WBID 3374), North Branch Wilsons Creek (WBID 3811), Pearson Creek (WBID 2737), and Wilsons Creek (WBID 2735). The City plans to address these impairments through their Memorandum of Understanding (MOU) and Integrated Plan (IP). The City requests the Department place these waters in either category 5-Alt or 4B for assessment purposes. The City restated comments previously submitted in regard to beneficial uses and comparisons to reference streams for Pearson Creek, Jordan Creek, Wilsons Creek, and North Branch Wilsons Creek.

Department Response

The TMDL development priority for these waters is currently set medium to low based on the pollutant and the [TMDL Prioritization Framework](#). The Department appreciates the City's comments and work to improve water quality through integrated planning. However, the Department has not received detailed enough information to categorize these impairments into Category 5-alt or category 4B with lower priority. The Category [5-alt guidance](#), located on the Department's [TMDL website](#), should be referenced for information and details needed to place a

water into category 5-alt. The Department looks forward to continued cooperation with the City and further clarification of how the Integrated Management Plan will lead to attainment of the impaired streams referenced in their comments. Additional information regarding scheduled improvements over time that will lead to water quality improvement would allow the Department to lower the priority of TMDLs for these waters even further. Prioritization for TMDL development will be reevaluated during the 2020 303(d) listing cycle using any new information provided by the City at that time.

No additional information was supplied in regard to the City's previous comments on beneficial uses and comparisons to reference streams for Pearson Creek, Jordan Creek, Wilsons Creek, and North Branch Wilsons Creek. The Department's [response](#) to previous comments has not changed and can be found on the Department's [303\(d\) website](#).

VI. Clarence Cannon Wholesale Water Commission

The Clarence Cannon Wholesale Water Commission submitted comments asking the Department to regularly monitor for Atrazine in Mark Twain Lake and other impoundments used for source water for drinking water treatment facilities. If Atrazine is found above the maximum contaminant level (MCL) in source water, the Department should take the necessary steps to require the manufacturer of Atrazine pay for the increased monitoring and place the water on the 303(d) list.

Department Response

As required by the Safe Drinking Water Act, all community public water systems are required to test finished water periodically for the National Primary Drinking Water Standards. Surface water systems test annually for atrazine, unless they have a detect in their finished water. If they do have a detect, they are placed on quarterly monitoring, sampling the second month of each calendar quarter. Compliance with Maximum Contaminant Levels is determined by calculating a running annual average of the quarterly sample results. The National Primary Drinking Water Standards are based on routine finished water sampling, which every public water system has to comply with. Raw water sampling, paying for any special sampling beyond the scope of the compliance samples contained in the Safe Drinking Water Act or requiring manufacturers to pay for sampling, is beyond the scope of the Safe Drinking Water Act or the Department's authority.

From a Clean Water Act perspective, the Department has the authority to monitor waters of the state for pollutants of concern that may impair designated uses. Regarding the monitoring and listing of Mark Twain Lake for atrazine specifically, the Department has the ability to monitor Mark Twain Lake should there be a concern with atrazine in finished water. If data show that the average concentration of atrazine in raw, unfinished water exceeds the water quality standard of 3.0 µg/L then the Department will list a lake as impaired. The raw, untreated water data that the Department has looked at (2010-2016) shows an average less than 3.0 µg/L. This data was collected by Syngenta and the U.S. Army Corps of Engineers, St Louis District.

VII. The Doe Run Resource Corporation

Strother Creek (WBID 2751 & 3965)

The Doe Run Resource Corporation provided comments that further clarified what work was completed to address the sediment and water impairments to Strother Creek. These comments were provided in response to comments made by U.S. Fish and Wildlife Service staff during the May 24, 2018 public meeting. There was concern about what has been done to mitigate the source of the sediment entering Strother Creek.

Department Response

The Department appreciates the additional comments provided by the Doe Run Company. The structural improvements and additional pollution controls put in place were adequate to address the impairments on Strother Creek. Specifically, the modifications to the detention basin in 2016 address the sediment impairments for this water body. Therefore, the Department maintains its decision to delist Strother Creek, but will prioritize Strother Creek for additional monitoring of compliance with water quality standards

West Fork Black River (WBID 2755)

The Doe Run Resource Corporation provided comments clarifying the events surrounding the samples collected from the West Fork Black River in July, August, & September 2014. Additionally the West Fork Mine treatment facility was upgraded in June of 2017.

Department Response

The Department appreciates the additional comments from the Doe Run Company. The exceedances that occurred in 2014 were the result of water that bypassed the West Fork Mine's waste treatment facility (MO0100218). The bypass of wastewater at the facility was a temporary event and is no longer occurring. The facility's discharge monitoring reports demonstrate that since the new treatment plant became operational in June of 2017, no permit limits have been violated. The new discharge fully complies with water quality standards.

VIII. Kansas City Water Services

Brush Creek (WBID 3986)

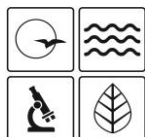
The Kansas City Water Services provided comments regarding Brush Creek (WBID 3986) and the PAHs impairment. Kansas City Water Services commented that two of the three sites used for assessment are in Kansas not in Missouri. The City requested that the stream be reassessed using only data from Missouri.

Department Response

The City is correct that two of the sites used to assess Brush Creek are located in the state of Kansas. However, the site that is in Missouri shows elevated levels of polycyclic aromatic hydrocarbons (PAH) consistent with the sites in Kansas. Assessing the stream on only the data

from Missouri still results in some PAH geometric means greater than 150 percent of the probable effects concentration. Incorporating the data from Kansas in the assessment demonstrates that the source of the PAH is not isolated to Missouri. In particular, the additional data indicate that PAH contaminated sediment is migrating from Kansas into Missouri. Brush Creek was originally put on the 2014 303(d) List by EPA using the 2014 Listing Methodology Document. Since Brush Creek has been listed previously, the Department must show good cause to delist the stream. As a result, Brush Creek will remain on the 2018 303(d) List for PAH.

Appendix A: Supplemental Data

**Missouri Department of Natural Resources****Wilsons Cr. - WBID 2375.00**

City of Springfield, Dept. of Public Works, US Geological Survey-WRD, Mo.

HUC 8: 11010002

Losing Stream Bacteria

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Time	Rec Season	Sample ID	Qualifier	Ecoli (#/100ml)
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	1	25	1325	N	222699		560
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	2	16	1610	N	222700	E	4
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	3	21	0940	N	222701		1500
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	4	10	1000	Y	222702		23
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	5	1		Y	271998	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	5	8		Y	271999		648.8
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	5	15		Y	272000		260.2
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	5	16	0930	Y	222703		20
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	5	22		Y	272001		261.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	5	29		Y	272002	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	6	5		Y	272003		285.1
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	6	12		Y	272004	>	2419.2
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	6	13	1215	Y	222704		42
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	6	19		Y	272005		114.5
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	6	26		Y	272006		110.6
Springfield MS4	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	6	28		Y	246881		21.1
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	7	10		Y	272007		152.9
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	7	12	0745	Y	222705		87
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	7	17		Y	272008		62.4
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	7	24		Y	272009		73.8
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	8	2		Y	272010		517.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	8	7		Y	272011		160.7
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	8	14		Y	272012		104.6
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	8	20	1300	Y	231620		44
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	8	21		Y	272013		107.1
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2012	8	28		Y	272014		115.3
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	9	19	0815	Y	231621		50
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	10	18	1510	Y	237821	E	42
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	11	13	1255	N	231623		51
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2012	12	10	1100	N	237822		25
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	1	9	0820	N	237823	E	4
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	2	5	1445	N	237824		52
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	3	5	0900	N	237825		59
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	4	9	1440	Y	237826	E	13
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	5	8	1710	Y	237827	E	32
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	5	21		Y	272015	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	5	28		Y	272016		95.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	6	4		Y	272017		307.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	6	11		Y	272018		290.9
Springfield MS4	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	6	13		Y	246886		126
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	6	13	0825	Y	237828		32
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	6	18		Y	272019		290.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	6	25		Y	272020		124.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	7	2		Y	272021		178.5
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	7	9		Y	272022		121.1
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	7	10	0735	Y	237829	E	380
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	7	16		Y	272023		111.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	7	23		Y	272024		77.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	7	30		Y	272025	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	8	6		Y	272026		1553.1
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	8	13		Y	272027		1203.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	8	20		Y	272028		68.3
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	8	20	1430	Y	237830	E	15
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2013	8	27		Y	272029		34.5
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	9	11	0825	Y	237831		68
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	10	23	1630	Y	237832		43
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	11	13	1355	N	237833	E	11
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2013	12	12	0830	N	237834		35
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	1	23	0810	N	237835		41

SUMMARY OF PROPOSED 2018 303(D) COMMENTS

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Time	Rec Season	Sample ID	Qualifier	Ecoli (#/100ml)
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	2	11	1540	N	237836	E	15
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	3	5	1600	N	237837	E	2
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	4	21	1000	Y	243727		29
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	5	20		Y	272030		95.8
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	5	22	0825	Y	243728		47
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	5	27		Y	272031		1119.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	6	3		Y	272032		93.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	6	10		Y	272033		1986.3
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	6	10	0810	Y	243729	E	1100
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	6	17		Y	272034		130.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	6	24		Y	272035	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	7	1		Y	272036		137.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	7	7		Y	272037		410.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	7	14		Y	272038	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	7	22		Y	272039		145
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	7	23	0830	Y	243730	E	18
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	7	29		Y	272040		77.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	8	5		Y	272041		83.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	8	12		Y	272042		325.5
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	8	18	1140	Y	250641		64
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	8	19		Y	272043		166.4
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2014	8	26		Y	272044		125.9
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	9	16	1930	Y	250642		240
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	10	16	0900	Y	250643		48
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	11	13	0840	N	250644	E	10
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2014	12	9	1110	N	250645	E	12
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	1	13	1600	N	255100	E	13
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	2	3	1130	N	255101	E	18
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	3	4	1115	N	255102	E	23
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	4	21	1030	Y	255103		76
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	5	6	0835	Y	255104		220
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	5	20		Y	272045		1553.1
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	5	27		Y	272046		261.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	6	2		Y	272047		204.6
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	6	9	1755	Y	255105		120
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	6	10		Y	272048		96
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	6	16		Y	272049		920.8
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	6	23		Y	272050		235.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	6	30		Y	272051		137.4
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	7	6	1520	Y	255106		580
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	7	7		Y	272052	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	7	8		Y	272053	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	7	14		Y	272054		275.5
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	7	21		Y	272055	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	7	28		Y	272056		172.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	8	4		Y	272057		74.3
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	8	4	1345	Y	255107		47
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	8	11		Y	272058		280.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	8	18		Y	272059		261.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	8	25		Y	272060		172.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2015	9	1		Y	272061		261.3
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	9	3	0740	Y	255108		280
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	10	7	0745	Y	255109		88
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	11	3	0750	N	255110		41
USGS	2375/7.3	Wilson Cr. at Roundtree Rd.	Grab	2015	12	8	1430	N	255111	E	8
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	5	24		Y	272062		1203.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	5	31		Y	272063		161.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	6	7		Y	272064		235.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	6	14		Y	272065		488.4
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	6	21		Y	272066		152.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	6	28		Y	272067		260.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	7	12		Y	272068	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	7	19		Y	272069		272.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	7	26		Y	272070		307.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	8	2		Y	272071		185
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	8	9		Y	272072		770.1
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	8	16		Y	272073		148.3

SUMMARY OF PROPOSED 2018 303(D) COMMENTS

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Time	Rec Season	Sample ID	Qualifier	Ecoli (#/100ml)
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	8	23		Y	272074	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2016	8	30		Y	272075		75.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	5	26		Y	272076		204.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	5	31		Y	272077		238.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	6	7		Y	272078		206.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	6	14		Y	272079		1046.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	6	21		Y	272080		161.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	6	28		Y	272081		172.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	7	7		Y	272082		218.7
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	7	12		Y	272083		123.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	7	19		Y	272084		101.4
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	7	26		Y	272085		517.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	8	2		Y	272086		74.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	8	9		Y	272087		141.4
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	8	16		Y	272088		387.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	8	23		Y	272089		410.6
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2017	8	30		Y	272090		131.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2018	5	23		Y	272091		178.9
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2018	5	29		Y	272092		218.7
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2018	6	5		Y	272093		172.3
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2018	6	12		Y	272094	>	2419.2
GCHD	2375/10.9	Wilson Cr. @ Bennett St.	Grab	2018	6	19		Y	272095		461.1
Average:											436.45
Geomean:											163.12
Exceedances:											81
Total Number of Samples:											148
Binomial Probability Type One Error Rate:											0.0000

*Sample is the average of two or more duplicate samples.

Losing Stream Bacteria

The water quality standard for Escherichia coli in a Losing Stream is 126 col/100mL as a maximum. The water quality standard allows no more than ten percent of the samples to exceed 126 col/100mL. To account for Type One and Type Two Errors we use the Binomial Probability formula to give us a Type One Error rate. The minimum allowable error rate is 0.1; a stream would be judged as impaired if the Type One error rate is less than 0.1.

Total Number of Exceedances:

81

Total Number of
Samples:

148

The Binomial Probability Type One Error Rate is:

0.0000

Thus Wilsons Cr. is judged as impaired for
Bacteria

Missouri Department of Natural Resources, Water Protection Program, (573)751-1300, www.dnr.mo.gov

http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

<http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>

8/21/2018 RAV